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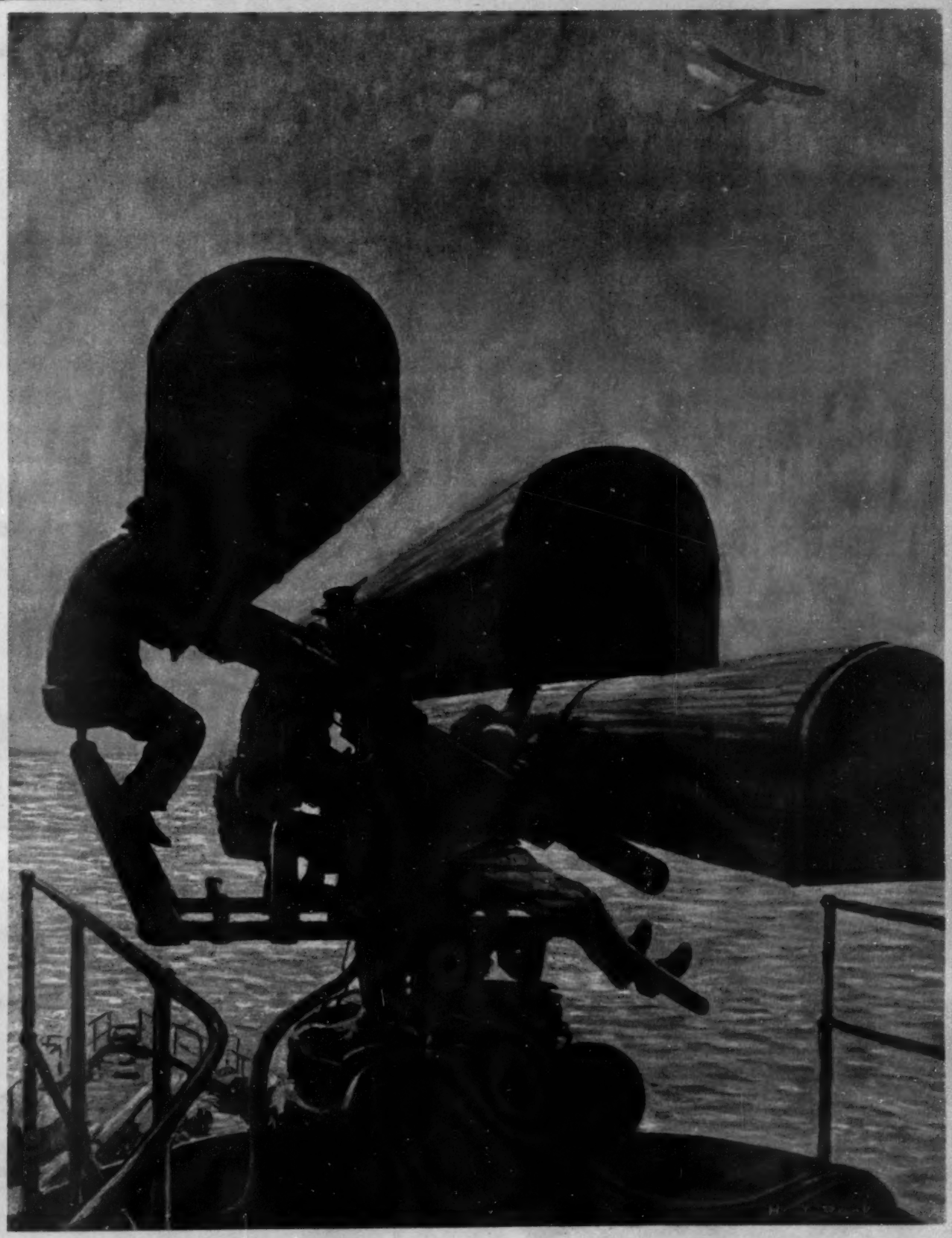

TAKING THREE SIMULTANEOUS READINGS WITH A TRIPLEX RANGE-FINDER ABOARD A FRENCH CRUISER—[See page 79]

August 4, 1917

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents

THE PROBLEM OF TRANSPORTATION

Is most vital. The nation is better equipped to produce than to transport. Rail congestion is certain to be felt with huge war burdens added to a peace traffic already beyond railroad facilities. Motor trucks must relieve it. At the same time cartage and urban delivery will increase with the volume of war business.

Horses must go, wherever trucks can do the work. Thus one driver can do the work of three or four. And *good* trucks must take the place of cheap trucks. Under ordinary conditions, it takes time to demonstrate the real economy of a high grade truck; under the stress of war, this economy will quickly appear.

But it is not so much a question of economy as of *performance*. The need for the best machinery money can buy will become imperative as high pressure operation breaks down and wears out everything else. The most load, the most miles, in the quickest time, day in and day out, month after month, year after year—only the best trucks can stand such a strain.

Under normal conditions, the number of days ordinary trucks are out of service for repairs is a greater loss to their owners than all the operating costs put together. Under war conditions, depreciation will be faster, days off duty will increase, just when operating needs are most urgent.

WHITE TRUCKS

Cost more to buy and less to operate, and they last. No service to which motor trucks can be put is too severe or too constant for White construction to endure.

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They Begin Where Others Often Quit

Sixty *Goodrich De Luxe* Truck Tires Average 13,498 Miles in One Year

ALL BUT FOUR STILL RUNNING

It's a good truck tire that will run 7,000 miles. That's the quitting point for many truck tires, but that's where **Goodrich De Luxe** Truck Tires, with their extra deep tread, usually begin to deliver the superior service that makes them famous.

In one year *sixty* **Goodrich De Luxe** Truck Tires piled up for Wilson & Company an average of 13,498 miles under service conditions by no means ideal. All but four are still running. None of them thought of quitting under 10,804 miles.

This record—a part of which is shown below—is typical of results obtained throughout the country by Wilson & Company and by other satisfied users. Specify **Goodrich De Luxe** Truck Tires on your next order and get the same gratifying service.

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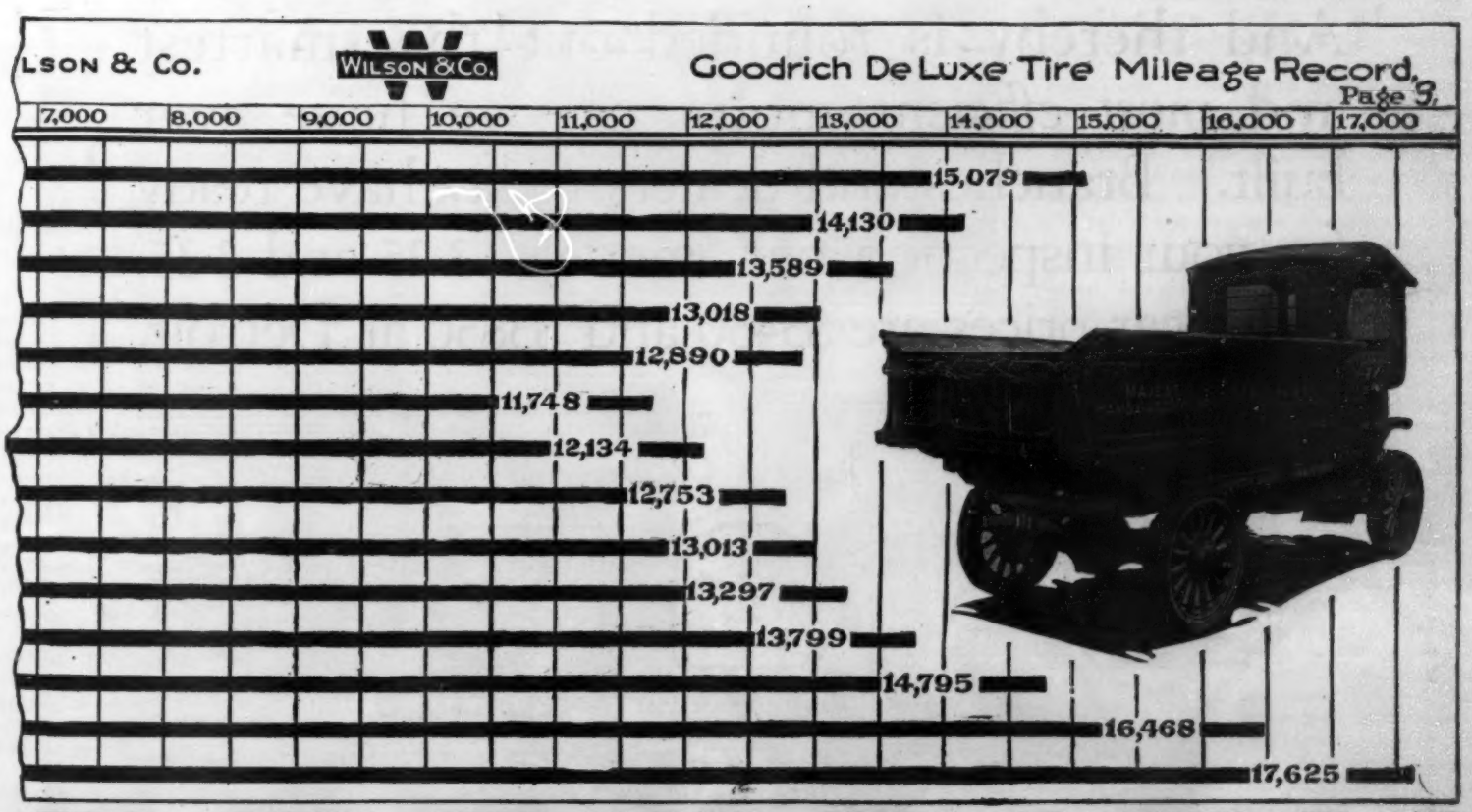
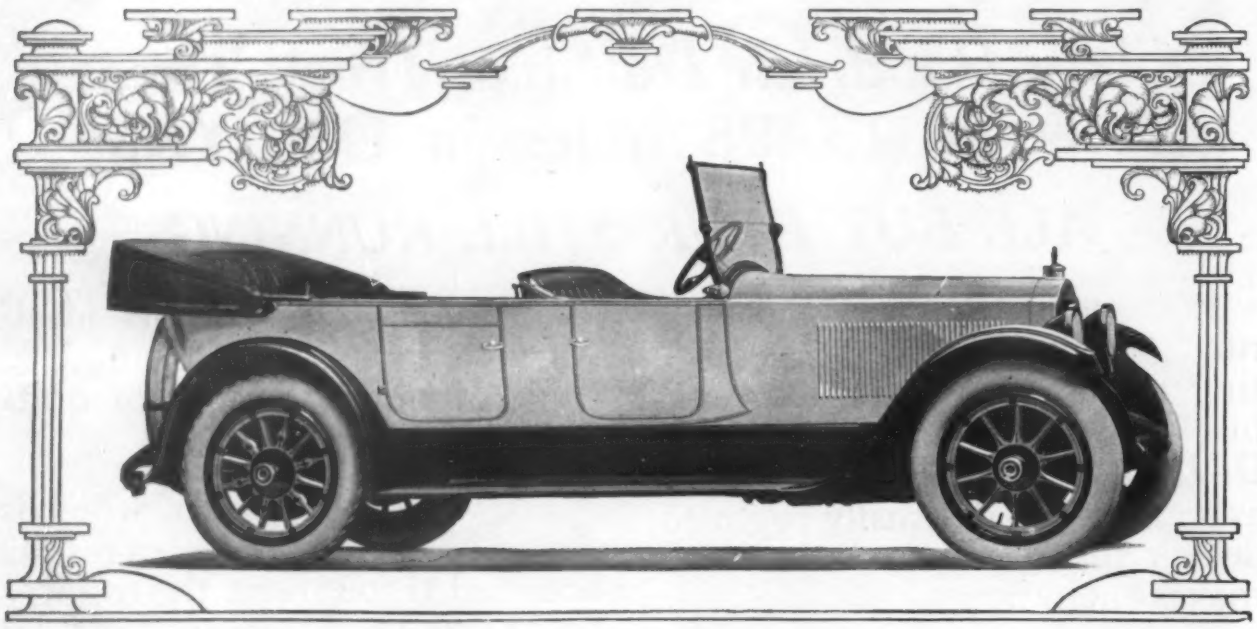


GOODRICH
TRUCK TIRES



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TWIN
SIX

"ASK THE MAN WHO
OWNS ONE."

SEVENTY-THIRD YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXVII. NUMBER 5] NEW YORK, AUGUST 4, 1917 [10 CENTS A COPY $4.00 A YEAR

Photographs by Cable

How the Korn Telegraphic Process is Extended to Submarine Transmission

SOLVING the problem of tele-vision has long been one of the outstanding dreams of the inventor. What the telephone is to the ear the tele-vision apparatus would be to the eye—a means of bridging space and receiving sense impressions from practically unlimited distances. Just as the voices of those connected by telephone are audible to one another so anything passing at one end of the tele-vision line would be visible at the other end.

While we are as yet far removed from the solution of this problem, another task of similar nature which likewise appeals in an uncommon degree to the human mind has been solved of late years. Telegraphic transmission of photographs, handwriting, drawings, etc., has reached a point where, until war interrupted international traffic and took over control of the world's telegraph and telephone lines, some of the foremost European papers made a feature of the publication of photographs received by wire.

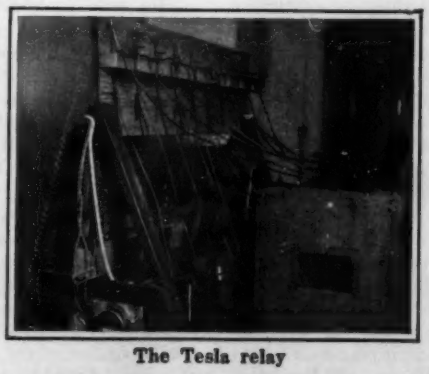
The question now arises as to whether what has been done on overland telegraph lines could not also be achieved over cable lines. The advantages thus obtained would of course be incomparably greater than in the case of the ordinary telegraph, on account of the much greater saving of time insured by cable transmission. And the problem, it seems, approaches solution at the hands of Professor Arthur Korn, the inventor of the photo-telegraphic process just referred to; all that is lacking, in fact, is the cable facilities for an actual working test of his method. That this lack has not embarrassed Professor Korn in his work is due to the fact that the picture to be transmitted is to cross the ocean in the form of a plain cablegram consisting of many thousands of letters, each corresponding to the light qualities of a given element of the picture. All questions connected with the problem could therefore be solved in the absence of cable lines, since the rôle of those lines in the process was a standard one.

It has been the present writer's good fortune recently to inspect Professor Korn's apparatus in his laboratory at Charlottenburg, near Berlin. He is therefore in a position to explain to the readers of the SCIENTIFIC AMERICAN, in the first account of this process published on the western side of the ocean, how the mysterious cablegram above referred to is obtained, and how it is reconverted into a picture.

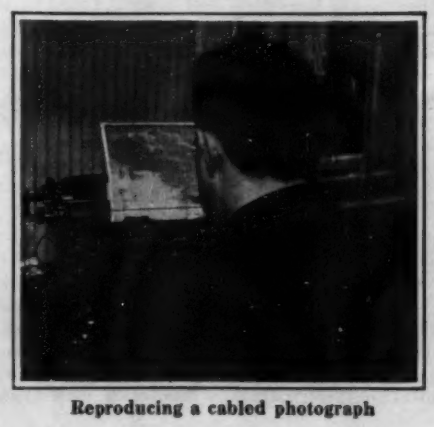
In its first stages, the new process is practically identical with Professor Korn's photo-telegraphic process for overland transmission, based upon the remarkable property possessed by selenium of undergoing variations in electric conductivity under the influence of variable illumination. A translucent film of the picture to be transmitted is wound upon the outside of a glass cylinder which, by an electric motor, is set rotating about its axis, while slowly advancing in the direction of this axis—a motion precisely that of the cylindrical phonograph record. Each point on the circumference thus describes a helicoidal line, so that the beams from a Nernst lamp (a type distinguished by its extraordinarily constant candle-power) which are thrown by a lens system upon a point of the cylinder, successively light up every point-element of the picture—again following the analogy of the phonograph, where the needle passes successively over all points of the record.

In the interior of the cylinder is placed a selenium cell. This is struck by the beams from the lamp, after their passage through the film. The darker the picture at any given point, the less light penetrates at that point to fall upon the selenium cell—and vice versa. At the bright places the beams pass through with practically no diminution of intensity, while the dark portions arrest them more or less completely, and intermediate shades produce an absorption inversely proportional to their intensity. Under the influence of this varying illumination the selenium cell varies in electric conductivity and the current intensity in the circuit fluctuates accordingly.

Prof. Korn at the sender of his cable-photo apparatus



The Tesla relay



Reproducing a cabled photograph

A photograph received over the cable in two sections

In the case of ordinary photo-telegraphy, these current fluctuations are reconverted at the receiving station into fluctuations of light, the process above described being, as it were, repeated in reverse order. These fluctuations of light, eventually fixed photographically, reproduce the original picture.

Inasmuch as this cannot be done in the case of a cable line, because of its very low powers of effective current transmission, the current fluctuations corresponding to the variations in shading of the picture, instead of being put directly upon the outgoing wire, are reconverted into what Professor Korn calls an intermediary cliché in the form of a letter cablegram. From this, transmitted in the ordinary course to the other end, the original picture can be reconstructed at any moment. Moreover, a further demand upon the inventor's ingenuity arises from the fact that the currents flowing through the circuit containing the selenium cell, necessarily feeble in order not to exceed the capacity of that cell, are unable to perform any mechanical work worth speaking of. They are therefore made to switch in stronger currents through the agency of a cleverly designed relay.

The feeble currents pass through an extremely sensitive moving-coil galvanometer, the needle of which undergoes deflection in accordance with their actual intensities. The deflected needle, which is of non-conducting material but carries at its ends small metal pins, passes on both sides below metallic sectors communicating with a source of Tesla currents, and above a series of contacts each connected with one of a series of circuits. As the needle is deflected into a position bringing its ends above a given one of these contacts, Tesla sparks will pass, thus allowing an alternating current to flow between the ends of a spark gap in the corresponding circuit. This circuit, since an electric arc to all intents and purposes acts like an electric conductor, is then closed, and a direct current of the appropriate intensity can pass through. The several circuits are connected with a high speed telegraph, in the perforated tape of which, through the agency of a polarized relay, the current thus flowing produces a given combination of holes. The valuable feature in connection with this arrangement, and one which would seem to admit of a multitude of other applications, is the absence of any friction worth speaking of, current closure being produced by arcs and Tesla sparks rather than by actual contacts.

From the above it will be understood that each combination of holes in the tape of the high speed telegraph corresponds to a given deflection of the galvanometer needle and, through this, to a certain current intensity in the selenium circuit and to a certain shading in a given point of the picture, which can thus be said to have been converted, point by point, into a series of perforations of the tape. This, however, in the high speed telegraph, can be in its turn translated into a series of letters, each corresponding to one element of the original picture.

An ordinary portrait is decomposed into 10,000 to 20,000

(Concluded on page 84)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

North Sea Net—A Civil Engineer's Job

NOT until the British Navy and our own realize that the building of a net across the North Sea is a Civil Engineer's job, will there be much hope of getting this great work done. Moreover, it is a job for the Civil rather than the Mechanical Engineer. The Mechanical Engineer is engaged in designing things that must be made to move—the Civil Engineer it is who grapples with the problem of putting up structures that must be kept from moving.

Essentially, the Civil Engineer's outlook is broad; his sense of perspective and proportion well established; and probably of all the great professions his is the least tied down to tradition—the most conspicuous for a broad faith based upon the granite rock of well-proved principles. Magnitude attracts rather than dismays him; and he is the last man to say that because some great thing has never yet been done, it never will.

As witness the great Brunel, answering his Sovereign's question as to the limit of the Engineer's ability by saying, "Give him unlimited men and money and there is nothing he cannot do." Or consider Sir Benjamin Baker spanning the Firth of Forth with his unprecedented cantilevers; or Roebling, flinging his spider's web of steel cables across the East River; or Gustav Lindenthal standing ready to stake his international reputation upon his ability to swing a 14-track railway bridge in a single 3,000-foot span across the Hudson River; or de Lesseps linking up the Mediterranean and the Red Sea; or Goethals cutting a Continental divide in two by a waterway that will pass ships 1,000 feet in length.

These men had faith, courage, vision, and above all that noble self-abnegation which is willing to assume a great risk to personal reputation for the sake of a great cause.

The reluctance of naval men, both in our own and the British Navy, to net the North Sea is confined chiefly to the older officers. The younger men believe the thing can be done and that the job should be put in hand forthwith. This reluctance is due to lack of experience on this kind of work, and even more to that hesitation to stake one's professional reputation upon something new and untried, which has acted and is today acting as a drag upon the daring and vigorous prosecution of this great war.

The training and experience of our naval officers does not fit them for such a giant's task as netting the North Sea. Their experience in ground tackle and mooring operations is confined mainly to dropping their "mud hook" in a roadstead, or making fast to a navy-yard dock. We would look for a more intelligent and less pessimistic estimate of the problem from the staff of the Coast and Geodetic Survey or of the Lighthouse Service, or from the resourceful and highly experienced officers of one of our maritime wrecking companies. Let such men as these foregather with the American Steel and Wire Company, and two or three eminent Civil Engineers, and the thing might be decided upon, and set in motion in a single morning's session.

An Engineering Chimera

RECENTLY the London *Lancet* predicted that carbon monoxide would grow to be the "terror of modern life." This fear was based, not alone upon the fact that this gas is being generated in unprecedented quantities, but equally upon the nature of the substance itself.

Poisons behave in various ways. Their effects may be local, or general, or both. They may act slowly or almost instantaneously. Effective antidote depends upon the possibility of catching up with the poison and rendering it inoperative before it is diffused through the system, or of undoing its action, once started. Thus acids may be neutralized by prompt doses of alkalis, while bichloride of mercury may be converted into an insoluble precipitate by immediate administration of white of egg. Aconite, which checks the heart action, may be counteracted by the stimulant digitalis, and morphia is a counter-poison to belladonna. But prussic acid, killing in a few seconds, outstrips any possible antidote effect. Finally, there is the question of dosage. The human mechanism possesses means of eliminating, in the course of the day's work, reasonable quantities of the slower poisons, so that it is often pertinent to inquire how much of a given poison may be safely taken.

In the case of carbon monoxide none of these considerations is of much weight. It is not merely that we have to do here with a colorless, odorless and tasteless gas, whose presence, short of chemical analysis, can be detected only from the symptoms. It is not merely that a very, very little is enough to cause rapid death, and that until death is imminent the symptoms of headache, nausea and general oppression are in no way to be distinguished from those of the periods of depression to which we are all more or less subject. The effects of carbon monoxide are even more serious than this would imply. The specific action of this poison is to attack the hemoglobin of the blood, forming with it a very stable compound which is not broken up even in the presence of atmospheric oxygen. In the very nature of the case every atom of the gas which is breathed comes in contact with the blood in the lungs and does damage to its full capacity. This damage is immediate and irreparable; antidote and counter-irritant are alike helpless to prevent or to repair.

Now the office of the hemoglobin is to act as carrier of the oxygen which the blood transports to every nook and corner of the human organism. It follows that the presence in the atmosphere of any amount whatever of carbon monoxide leads inevitably to impaired efficiency of the blood; and when breathed for any length of time the effect is cumulative. So it is fast being recognized that exposures to carbon monoxide which would once have been considered trivial are not to be tolerated. Thirty years ago a special commission reported that the high death rate from pneumonia in the mines of The Rand, Transvaal, was due mainly to the presence of carbon monoxide. In recent years suits hinging upon the development of this disease after apparent recovery from monoxide poisoning have passed through the British courts. French investigators have been particularly impressed by the action of carbon monoxide in causing heart weakness, and here too there are many cases of grave disorders following what seemed to be complete recovery from the effects of the gas. Accordingly the action of the poison must be recognized as a dual one. In addition to the immediate, acute, and potentially fatal effects of which we ordinarily think in connection with poisoning, we must consider the slower and more insidious action of carbon monoxide in lowering the vitality and increasing the susceptibility to a wide range of pulmonary, cardiac and circulatory diseases. This aspect of the case is a serious one, and one free from all connection with the immediate symptoms of the poison and the danger of direct fatality.

All this is inspired by the fact that we carry on another page of this issue a communication from a correspondent whose position in the technical world makes it necessary to take his remarks seriously. This gentleman criticizes the proposed Hudson River Vehicular Tunnel on the ground that adequate evacuation of the carbon monoxide generated by the operation of automobiles through it would be out of the question. In reaching this conclusion he is at direct variance with the engineers engaged by the Public Service Corporation to report upon the ventilation question.

We have checked his arguments and figures carefully and find in them no error. The absolute correctness of all his findings and the exact cost of adequate ventilation are, however, matters of little import in the presence of the outstanding facts that the engineers of the Public Service Corporation have put themselves on record as endorsing a scheme of ventilation based, confessedly, upon a permanent carbon monoxide content in the tunnel atmosphere of two-tenths of one per cent, and upon the apparent assumption that any amount of this gas which cannot be convicted in their eyes of immediate and violent manslaughter is entirely tolerable. The extraordinary quotations which our correspondent makes can only mean that these engineers have attempted to consider the subject of monoxide pollution either with unbelievable cynicism or with equally incredible ignorance of the working of this king among poisons. The facts which we have adduced make it clear that in dealing with this as with no other poison the question of what constitutes a safe dose is not a pertinent one. There may exist substances which in doses of twenty-eight ten-thousandths dilution will cause death by convulsions in two minutes, and which when diluted to twenty ten-thousandths become wholly harmless; but carbon monoxide is not one of them. It is as certain as anything well can be that human beings, forced repeatedly, and for the duration of an automobile passage through this tunnel, to breathe an atmosphere containing one part of carbon monoxide in five hundred, would become extremely susceptible to every disorder of heart, lungs and circulatory system, and that many of them would succumb to one of these maladies. We are by no means sure that the one-in-two-thousand monoxide content proposed as a basis of argument by our correspondent would be free from such effect; it is surely clear why no greater pollution can be regarded as permissible.

From the standpoint of the prospective users of the proposed tunnel there is perhaps nothing to get excited about in the Public Service plans. It is plain enough that the tunnel could not be used for automobiles, and that accordingly the proposition to kill off our chauffeurs and truck drivers with all sorts of organic disorders is being made with no real threat of eventual execution. But the vehicular tunnel, being a public utility, is, if it ever gets built, to be financed through an arrangement which in the last analysis reduces to construction with the taxpayers' money. Accordingly, first and last, the taxpayers have a paramount interest in the matter. If the tunnel be built, they will pay for it, regardless of whether it can be used for automobiles. Consequently, all facts in the matter should be put before them without reserve. Those responsible for the report which we join our correspondent in condemning should know, if they do not, that the statements upon which we have based our judgment are facts. We hesitate whether to condemn more strongly their action in ignoring these facts and the extraordinary levity with which they dismiss the work of experts in the field of gas poisoning, or their offense against the public at large in promulgating their own findings in support of such a wholly questionable undertaking. On both grounds they lay themselves open to the severest criticism.

The War and the Anti-Trust Principle

ONE of the most startling results of the pooling of our railroad resources under semi-Governmental control is found in the measures now being taken to relieve the car shortage where that shortage has most imperilled the work of war preparation. Thus, lumber for our army cantonments comes from the Carolinas, Florida, Alabama, Mississippi, Louisiana, Arkansas and Tennessee. The railroads operating in these states are in many cases deficient in equipment, but even when in possession of the normal number of cars per mile of track they have been wholly unable to handle the tremendous shipments of such a bulky commodity as lumber.

Under the direction of the Railroads' War Board these conditions have been met by wholesale transfer of cars from other sections of the country. Railroads in the east and northeast, as well as those of the central states, have been ordered to send cars to the roads in the affected regions, regardless of the ownership of the cars. These are being moved empty, in the largest trains practicable, and at utmost speed. In all, 68,814 cars have been ordered temporarily transferred in this manner. The chief beneficiaries are the Louisville and Nashville, 6,737 cars, the St. Louis Southwestern, 5,949, the Illinois Central, 5,777, the Mobile and Ohio, 5,284, and the Atlantic Coast Line, 4,300. Among the donors of these cars the Pennsylvania and New York Central stand first, with 18,709 and 9,163 cars; but perhaps the Boston and Maine, with 5,692, has loaned a larger proportion of its equipment than any other line.

This step marks a great advance in rational treatment of our war-time problems. It is only by a very long stretch of the imagination that one can conceive the railroads of West Prussia and Baden unable to handle all their business while the lines in Saxony and Silesia have thousands of idle cars; yet an analogous situation in the United States is far from being the figment of a disordered brain. That for the duration of the war we have got away from such nightmares seems established, and is surely a matter for congratulation. Perhaps we may even be permitted, without danger of prosecution under the Sherman Law, to speculate as to just how far such eminently reasonable coöperation between "parallel and competing" roads will be permitted to become a regular feature of our railroad economy after the return of peace. Faced by the fact that our railroads are now being operated practically as a single system, we must surely find it significant that as a first measure of efficiency the Government is constrained to do with the railroads things which it has not been willing to permit the railroads to do with themselves.

Big Gun Steels

IT is reported that Germany is lining her big guns with a uranium steel which stands up at a rate of fire destructive to all other known steel alloys. A necessary preliminary to the use of such a substance is a supply of ferro-uranium. This is ordinarily obtained from the uranium oxide which comes as a by-product in the extraction of radium from its ores. Accordingly it presents a problem for the electric furnace. This matter is being looked into by the Bureau of Mines, in connection with Cornell and other Universities.

Electricity

Trimming Hair by Electricity.—By means of an electric hair-cutting machine recently developed it is said that the barber can do his work in five minutes, and records of three-minute hair cuts have been made. The hair-cutting machine is driven by a motor rated at one-twentieth horse-power, through a flexible shaft and a worm in the hair-cutter proper. A crank attached to the gear operates the clipper with a sliding motion. It is claimed that the electric hair-cutter performs its function in a short time and with small discomfort to customers. In order to increase the usefulness of this device, the hair-cutter can be removed and a vibrator attached to the flexible shaft in a few seconds.

Heating Element for Industrial Applications.—Consisting of a ribbon wound on a number of fire-clay bushings assembled on two steel tie rods between two pressed-steel end plates, a newly introduced heating element offers a ready means of converting any existing oven into an electric oven, particularly for such work as baking and drying in enameling and japanning operations. The ends of the ribbon are secured to drop-forged steel terminals which are clamped to the steel tie rods, the rods thereby becoming the terminals of the heaters. These rods are insulated from the end frames through which they pass, and the ends are threaded for bolting on the connectors. Cold-rolled steel bus-bars are recommended and may be mounted directly above the heater on insulators bolted directly to the end frames. Hooks are used for hanging the heaters on to the usual supporting steel work, which may be flat iron, angle or channel iron or pipe work. Protecting screens may be attached directly to the end plates.

Listening to the Atlantic and Pacific Simultaneously.—A remarkable demonstration of the wonderful telephone network which extends over the entire United States was recently made for the benefit of Lord Northcliffe and his party on the occasion of their visit to the offices of Theodore N. Vail, president of the American Telephone & Telegraph Company, in New York city. A point of historical interest was the listening by the distinguished visitor to the roar of the Atlantic and Pacific oceans simultaneously. A telephone was connected to the transcontinental line reaching to San Francisco where the line had for the occasion been extended to a telephone transmitter on the shore of the Pacific at the Golden Gate. Another telephone was connected to a line extending to a transmitter on the shore of the Atlantic. Thus by placing his ear to one receiver and then to the other, Lord Northcliffe was able to hear first one ocean and then the other, and by placing a receiver to either ear he was able to hear both oceans simultaneously.

Electricity and Post-Bellum Industry.—Much attention is being given to the investigations and recommendations of the committee appointed by the board of trade of Bradford, England, to report upon the possibilities of extending and interconnecting various sources of supply and providing economical and convenient electric power for British industries. The full report of the committee is not yet available, but a great deal of discussion upon the subject has recently appeared in the English press. It is suggested that a national power-distribution system is as important as national railway, road, telegraph and telephone systems, and stress is laid upon the advisability of insuring that there shall be an adequate and economical supply of power for all classes of consumers in the United Kingdom, particularly industries that depend upon a cheap supply of power for their development. The intercommunication of existing municipal electric plants and the establishment of central generating stations are among the questions now being given practical attention.

Why South America Does Not Use Rigid Conduit.—There is no market for rigid conduit in Ecuador, Peru, or Bolivia. Several reasons may be given. There are no rules or regulations covering electrical installations which would require the use of conduit. That being the case, no one is going to put in the material when it adds to the cost of his installation without giving him any advantage. In fact it would be a disadvantage, because every householder does most of his own wiring and wants to have the wires exposed, so that he may get at them easily. There is no advantage in any of these countries, with the possible exception of cases in the city of Guayaquil, in using conduit as a protection against fire caused by damaged wires, as all the houses, including inside walls and partitions, are made of adobe or volcanic rock, both of which are non-inflammable. It would be necessary to run the conduit on the outside of the walls, that is, not concealed as is the practice in frame houses, and the flexible cord which is universally used for house wiring is less conspicuous. The high cost of the steel conduit laid down in these countries, on account of freight and duty charges, is quite prohibitive. It is largely for this reason that not even the European systems of tubing are used to any extent.

Science

The Fourth Annual Conference of the Society of Practical Astronomy will be held August 16, 17 and 18, 1917, at the University of Chicago. Prof. F. R. Moulton of the university, and Prof. W. D. MacMillan will lecture at the sessions, and there will be interesting papers presented by other members of the Society. The sessions are open to the public and visitors from other cities, whether members of the Society or not, are invited to attend.

Fertilizers and Weather.—Some recent investigations in Sweden bring out the fact that the weather conditions of the year greatly influence the amount of fertilizers required by plants. The more favorable the meteorological conditions for plant growth, the less was the absorption of mineral fertilizers, such as sodium nitrate alone or in addition to manure. It appears that when the weather is such as to increase the absorption of the nutritive substances of manure, plants have less need of the nutritive substances contained in mineral fertilizers.

A New Rainfall Map of the United States has been issued by the U. S. Department of Agriculture, as the first installment in the meteorological section of the great atlas of American agriculture which the Department has had in preparation for some time. The new map is a much more detailed presentation of the annual precipitation of the country, especially of the western states, than any previously published. It was prepared in the Weather Bureau, and is based on 20-year records from 1,600 stations, together with about 2,000 shorter records, adjusted to the 20-year period.

Temperature and the Rotting of Apples in Storage.—Extensive studies on the temperature relations of various apple rot fungi have been made by Messrs. C. Brooks and J. S. Cooley, as a contribution to the problem of storage. With most of the species of fungi studied the initial incubation stages of growth on the fruit were found to be more inhibited by low temperatures than the later stages, indicating the desirability of immediate as compared with delayed cold storage. The optimum and limiting temperatures for growth vary considerably in the different species. The detailed results of these investigations are set forth in the *Journal of Agricultural Research*.

An Advisory Board on Wild Life Protection has recently been appointed by the Canadian Government, and special efforts will be made to preserve the fur-bearing animals and big game that constitute the chief natural resource of the Northwest Territories. In this connection it is interesting to learn that more than 3,000 head of bison are now under government protection in Canada. These include about 2,400 in the herd, originally of 750 head, purchased in the United States in 1907 and kept in the buffalo park at Wainwright, Alberta; and a wild herd of about 500 in the Peace River region southwest of Great Slave Lake. The Canadian Government is carrying on experiments in crossing bison with domestic cattle.

A Census of Incunabula in America.—A committee of the Bibliographical Society of America, with headquarters at the Harry Elkins Widener Memorial Library of Harvard University, is engaged in bringing down to date and preparing for publication a list of the copies of books printed in the fifteenth century, which are owned in the United States and Canada, the original list having been undertaken some twenty years ago by Mr. John Thomson, of Philadelphia. The census now consists of about 10,000 titles, with notes of ownership as reported about 1900. Most of these books are in large public libraries. It is estimated that there are at least a thousand fifteenth century books hidden away in private book-cases in this country. Anybody who owns such a book should report the fact to Mr. G. P. Winship, of the library mentioned above. The list is to be published in the near future by the New York Public Library.

"Diseased" Meat and Fish.—An important distinction that is sometimes overlooked between the meat of diseased animals and fish on the one hand and meat that is likely to cause disease in the human consumer on the other is discussed by Dr. C. W. Stiles in the *Journal* of the American Medical Association. The writer maintains that the vendor of live shellfish, poultry, fish and other raw foods is justified in assuming that such food will be properly handled and prepared for human consumption by the purchaser. For example, the absence of live trichinae in fresh pork cannot be guaranteed by any known practical method of inspection, but if the pork is properly cooked any trichinae present are killed and rendered harmless. In connection with nematodes which were found in certain samples of butterfish, Dr. Stiles points out that although these fish were diseased in the literal sense, the encysted worms were present chiefly in the entrails, and if properly dressed and cooked the fish would not be liable to produce disease in man.

Automobile

The Lubrication Question.—That the last word has not yet been said on the matter of lubrication systems is evident from the fact that cars and trucks using splash lubrication in their motors, and in heavy service, side by side with others equipped for circulation of the oil, are standing up and giving equally satisfactory results. It may be, however, that the human element has something to do in the matter.

A French After-the-War Model.—The suggestion has been made in France, with a view to international competition after the war, that a design be made up that incorporates the best features of every manufacturer. Such a plan would certainly produce a good car, but it is difficult to see how the plan can be carried out unless a syndicate is formed of all the manufacturers. It might be possible, however, to build the chassis to such a design, and leave the body design to the individual maker.

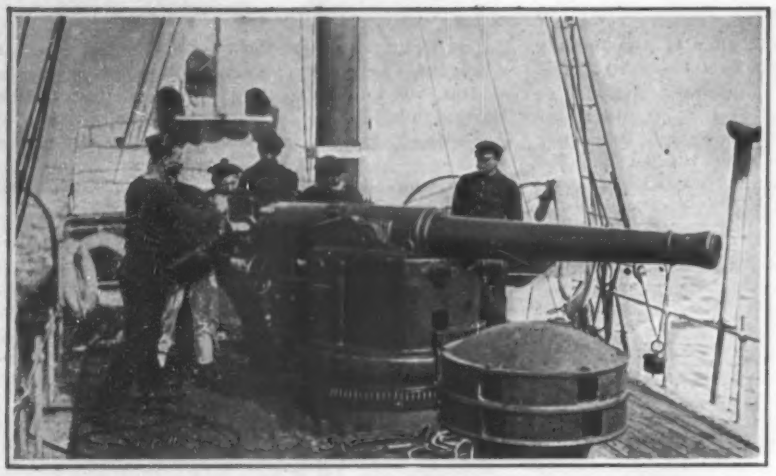
Gasoline and Insanity.—When the ordinary, normal citizen encounters a brick on the sidewalk he takes a deliberate observation of the obstruction, and then carefully negotiates a safe course around it; but immediately he gets his hands on the wheel of an automobile he is obsessed with an insane desire to drive through or over everything he meets. There must be something in gasoline that induces such cases of temporary mania, and some scientist should take the matter under investigation.

Increasing Engine Efficiency.—In view of the increasing price of motor fuel, attention is being given to increasing engine efficiency, and one way to accomplish this is to increase compression in the cylinders. With our present engines pre-ignition is often experienced, although the compression pressures are not over eighty to one hundred pounds; but this is not caused by the general temperature of the interior of the cylinder, but by some point that gets hotter than the rest, such as the spark plug or a valve. If this feature were corrected by careful cooling arrangements it would be possible to use a much higher compression ratio, with a corresponding decrease in the size of the cylinders.

Teaching the Beginner.—When giving first instructions to a beginner in automobile driving it is by no means convenient for the teacher to have to reach over to the steering wheel, and even less so to reach the brake in a case of emergency. To overcome these difficulties an English instructor has fitted a car with an auxiliary wheel, connected with the regular wheel by a chain running over a sprocket on each wheel shaft, and also a second brake pedal attached to the shaft of the regular pedal. By this arrangement he is enabled to take instant control at any time; and it also enables him to easily correct a tendency to sawing, which afflicts many a nervous driver. This device is especially valuable in teaching women to drive.

The Climbing Power of Aeroplanes.—The *Autocar* (London) says, "It is always easier to motorists to realise aeroplane performances if they can be reduced to motor car equivalents. They are more likely to be impressed with the information that an aeroplane will climb at 60 miles an hour than if they are told its rate of ascension is 1,300 odd feet per minute. As a matter of fact, a good modern aeroplane weighing all of about twenty-four hundredweight, and having an engine of a brake horse-power of 180, would climb a gradient of 1 in 3½ to 1 in 4 at about sixty miles an hour; that is what rapid aerial climbing really means. Twenty-four hundredweight is about the same weight as an average 15 horse-power four-seated open car complete, but without its passengers. A good many of the aeroplanes now in use weigh more and a few somewhat less.

Good Roads Prospects.—Very little is heard of good roads propaganda now-a-days, and on the other hand there is a prospect that a serious crisis will develop before long that will operate against the movement, for many miles of road have been built with funds secured by the sale of 25-year bonds which will be entirely worn out in ten years, and the communities will be burdened by interest for fifteen years on roads that have ceased to exist. The condition arises from two causes: First, because the public does not learn that it is equally as important to provide for the maintenance of a road as to build it; and second, because many of these roads were built under the supervision of politicians who know nothing of road building, and who care only for the perquisites they extract from the contractors. Thousands of miles of roads have been accepted by county officials that appear beautiful to the eye when new, but which have wholly inadequate foundations, and are constructed of improper materials. In many cases, moreover, misdirected enthusiasm has led officials to build more miles than the funds available justify, with the result of flimsy construction that cannot be expected to last. The obvious remedies are to eliminate the politician, build less mileage at a time, but build that substantially, and, most important of all, provide for constant maintenance instead of periodic rebuilding.



Gun of early type mounted on a French ship. The exigencies of the submarine warfare have restored many such relics to service

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Five-inch guns and range finder on forecastle deck of a U. S. cruiser operating in the submarine zone

The Submarine Problem—X.

The Gun as an Answer to the Submarine

THE SCIENTIFIC AMERICAN has placed itself on record as believing that the only effective means of meeting and defeating the German submarine campaign is to keep the U-boats out of the Atlantic by shutting them up within the North Sea.

It is our belief that this can be done by building a continuous mine-barrier from the northerly point of the Shetland Islands across to the coast of Norway. This is the alternative method to the one which the Allies, including ourselves, are following; which method is to let the submarines scatter on the high seas, and then start a still hunt for them by means of destroyers, patrol boats and converted yachts.

The British Admiralty, with the "say-so" in this matter, object to building the net. First, for the reason that they claim it cannot be built and held in place; and, secondly, because they object to having any obstruction of this kind across the North Sea which might interfere with the free movement of their Grand Fleet should the German High Seas Fleet come out for another trial of strength. This being the situation, the Allied fleets are committed to "submarine chasing."

The situation was put rather tersely to the writer the other day by a British naval officer who said: "Let the American inventor find the submarine for us and we will answer for killing it." This seems to us very much like begging the whole question; for anyone who has engaged in the hilarious pastime of fly or mosquito swatting knows perfectly well that if he can find the fly he can kill it. However, since we seem to be committed to a policy of letting the submarines roam the seven seas and choose their own time and place of attack, and since a destroyer or patrol boat cannot be in half-a-dozen places at one and the same time, the best thing to do is to arm the merchant ship and give it a chance to do its own killing.

In the course of the present series of submarine articles, we have illustrated quite a number of protective devices for ships which have been adopted or proposed—mostly proposed—and we do not hesitate to say that the most effective, as well as the one which is being most widely

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French anti-submarine gun equipped with telescope sights

applied, is the mounting on the merchant ship of a good rapid-fire gun, and placing back of it a trained gunpointer, or "gunlayer" as the British call him, who can hit the target nine times out of ten under reasonable conditions of range and visibility.

We present in connection with this article a few pictures showing guns which have been actually mounted on merchant ships. No doubt to the eye of the expert gunner it must appear to be a rather miscellaneous collection—and necessarily so; for when the call came for the arming of several thousand merchant ships post-haste, the various Navy Departments had to use what they could lay their hands upon, and many a gun which had gone to the storehouse because it was no longer serviceable for the crack ships of the fighting line of the Navy was brought out and mounted for merchant ship defense. These guns vary in caliber all the way from the 3-inch up to the 6-inch; and though many of them may be minus telescopic sights and other refinements of modern naval artillery, they are still quite capable of reaching the submarine at any range at which the "sub" can fire its torpedo with any reasonable prospect of scoring a hit, and the shells, when they do get home, are quite capable of broaching the light plating of a submarine sufficiently to put her out of commission.

In view of the fact that most merchant ships today and all merchant ships within a few weeks' time will go armed with guns that are effective at from 5,000 to 8,000 or 9,000 yards, it is probable that the Germans are blaming themselves for want of foresight when they cut down the range and speed of their torpedoes in order to double up on the charge of explosive in the warhead. That policy was all right when merchant ships were unarmed and the shark of the sea could sneak up within a few hundred yards of its helpless victim and put one or two torpedoes into her without the least risk to itself; but when the rapid-fire gun began to poke its long snout over the taffrail of the merchant ship, Fritz realized that the boot was very much on the other leg. Either he must take chances on a long shot at a ship whose speed and course he could only approximately estimate, or he must take the risk of coming up within gun-shot range, with the chance of being disabled or sent to the bottom. But though the new situation was perplexing it was by no means hopeless, and the Germans have responded by building larger boats and mounting much heavier guns in the open. The latest U-boats carry

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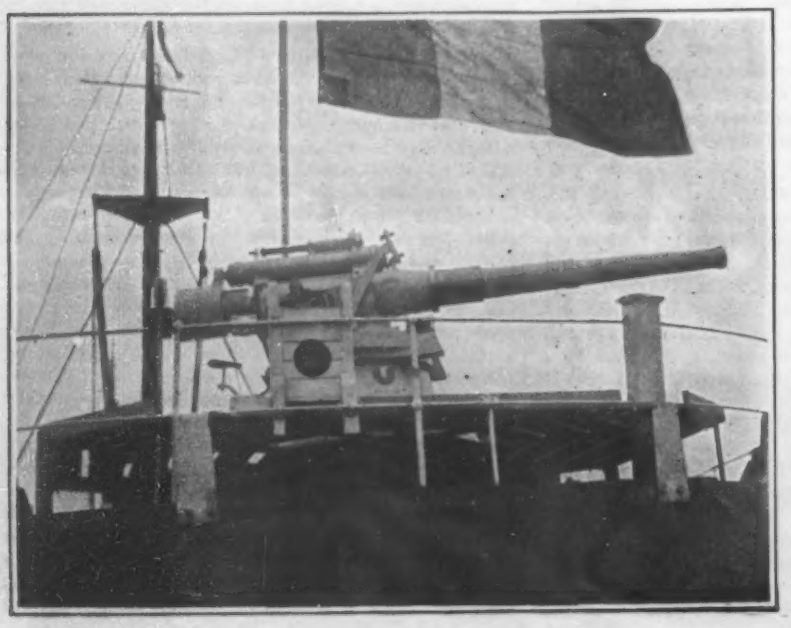
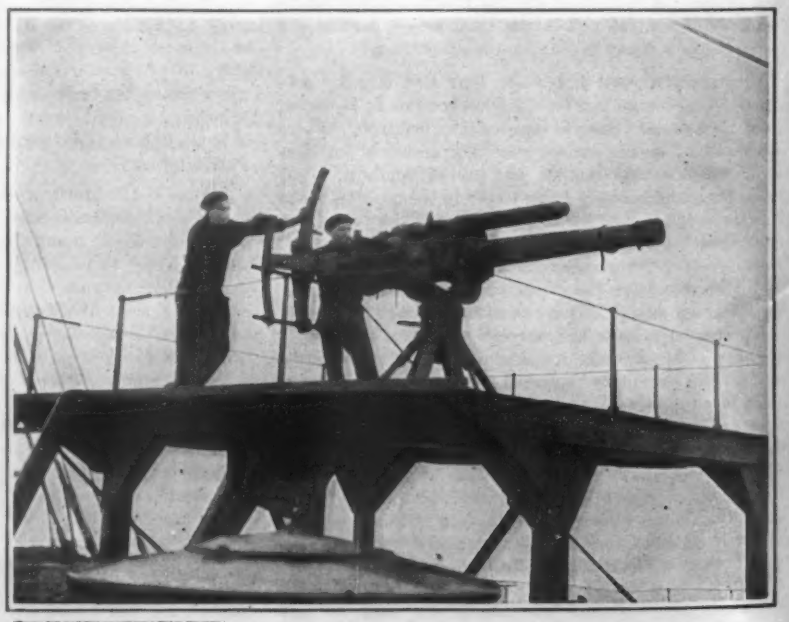


Four-inch gun mounted on a French merchant ship



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Three-inch gun on special platform at stern of British ship

Mechanics and Mathematics of the Draft

Outstanding Features of the Process through which 687,000 Young Americans Will Be Called to the Colors

By C. H. Claudy

THE United States, with the strictest of laws against lotteries or contests of any sort in which the element of luck plays a part in the securing of a prize, has just completed the greatest lottery drawing ever attempted. The prizes were not monetary, but the call to the colors, or the possibility of not being called (according to individual viewpoint!) and the "game of chance" was specifically authorized in law.

No lottery for monetary gain, in old world or Louisiana State lottery, was ever simpler in mechanism, or more hedged about with precautions to insure absolute fairness.

Ten thousand five hundred numbers were drawn, which means that every registered man had one chance in 10,500 of being called first, one chance in 10,499 of being called second, if not called first, one chance in 10,498 of being called third, if not called earlier, etc. Inasmuch as the 4,557 registration districts had different numbers of registrants, any one single draft number might skip registrants in small districts. Thus, a district with 257 registrants only was not called upon by the first number drawn (258), but the chance, as a chance, remained the same—one in 10,499—that a given man from that district be named second.

There has been some comment that inasmuch as the total number of numbers drawn exceeded the greatest registration in the largest district, the drawing was not strictly proportioned by chances to the number of men registered. That this is an erroneous statement, a moment's thought will show. Had there been 21,000 numbers, instead of 10,500 the result would have been the same, the numbers above the highest number of registrants merely being discarded and having no effect on the lottery as such.

The precautions taken to make the drawing absolutely a matter of chance were such as can give the most rabid anti-conscriptionist no points on which to hang an argument. The numbers, in red, on white paper, black on the other side, were rolled, black side out, and inserted in gelatin capsules like the familiar five-grain quinine dose of household use. It was impossible upon the closest scrutiny to read the number inside the capsule. All the capsules were alike. But while a searchlight might have been turned on the glass bowl holding the 10,500 capsules and the most eager and interested man allowed to pick by sight, without in any way affecting his ability to determine one number from another, only blindfolded men were permitted to draw. The mass of capsules was stirred constantly with a spoon, and so thoroughly were they mixed that, throughout the drawing, two consecutive numbers were in no case drawn one after the other.

Secretary of War Baker drawing the first capsule, containing number 258, from the big bowl

Different numbers drew different numbers of men. Thus, for instance, numbers one, two and three, etc., drew in each case 4,557 men for service—or for summons for examination—since no registration district but had its numbers one, two and three. But the higher numbers drew less and less men, as they were nearer and nearer to the top figure. For instance, in the capital of the nation there were eleven registration districts. The smallest registration in any was 1,642. Any number from one to 1,642 drew one man from each of the eleven districts in Washington. Up to 1,927, the next smallest number registered, any drawn number called ten men, up to 2,590 called nine men, and so on up to 3,704 and below 3,721, which numbers called but one man from Washington.

On a larger scale, this happened all over the country. In other words, each number represented a group of men, the members of which are scattered all over the country, these groups varying in size. Each drawn number summoned a group but, regardless of the size of the group, one group was exactly as liable to be called first, or last, as any other group.

As the numbers were drawn by a blindfolded man, the capsule was broken, the number read aloud, checked, entered on lists and written on a blackboard. Had every man in the drawing been intent upon avoiding some one number, it would still have been impossible. The blackboard with numbers listed in the order in which they were drawn, held 1,000, and it was photographed after each filling. Chicanery, trickery, influence, pull, graft—they were all helpless before the utter simplicity and the absolute inexorability of this simplest of lotteries.

In spite, however, of the utmost precautions in preparing the capsules, there was one error. The 10,004th capsule drawn had no number in it. Later it was ascertained by checking that this missing number would have called all men numbered 4,664.

At the time the blank was drawn, it was hastily decided to make the 10,005th drawing fill the 10,004th place, which made the total drawn from 10,499 instead of 10,500. The manifest, if theoretical, unfairness of this, later became apparent and 4,664, when it came to light as the missing number, was promptly inserted in the 10,004th place, where it belonged. Practically, the matter is of no importance, since men called so late in the draft will in all human probability never be summoned to the colors. But the principle is the same, and had the blank number come out, for instance, on the 500th draw, and not been inserted in its proper place, but eliminated entirely, all these men listed by that number would actually never really have been in the draw at all.

No one knows how the error occurred, nor does it matter now, nor has it the slightest effect upon the absolute accuracy of the draft.

That errors were so few is a matter of wonder, yet also one of congratulation, because, when matters of life and death hang upon gelatine capsules in a glass bowl, it is well that the American spirit of absolute fair play be fully satisfied.

Another little difficulty presented itself in the case of 6,689 and 6,899. Upside down, either one becomes the other. Both were recorded as the same number, though widely apart in the drawing. It was ruled that the first number of these two recorded was correctly recorded, the second one being the true other of the pair. Like the case of 4,664 the matter is more theoretical than practical.

A complete system of checks and rechecks was resorted to before the final sheets were made up to send out. The tally sheets as recorded by the tally markers and the blackboards were compared in order that there might be no errors. The final master sheets, eleven to a set (ten of 1,000 numbers, numbered in order and one of 500, numbered in order), have been printed and sent to each registration district, where the matter of calling the quota demanded in the first draft will be attended to.

There were a few oddities in the draft worthy of mention. Number 2, the 10,312th number drawn, was drawn exactly at two o'clock in the morning. Number 13 refused to live up to its usual reputation and was not drawn at thirteen minutes to or after any hour. Of course, it was drawn on Friday but—so were all the other numbers.

Number 258, the first number drawn, and to some men, therefore the unluckiest number of all, is, curiously enough, the room number of that chamber in the municipal building in New York, in which marriages are performed, and in which hundreds of young men accused of being "marriage slackers" have recently taken unto themselves wives. The authorities of the marriage license bureau are pointing this out to would-be slackers as an omen!

As a result of the drawing every registered man in the country is given a definite place in the liability for service list. Already 687,000 have been ordered to the colors to fill to war strength the regular army and national guard and to constitute the first increment of the national army. To secure that total, 1,374,000 men will be called for examination within a few weeks, estimating that two registrants must be called for every soldier accepted. These 1,374,000 will be taken from the head of the liability list, every local district furnishing a fixed quota.

No further drawings will be necessary as long as any eligible registrant is not under training. Only in the event that a new registration calling men between the ages of thirty-one and some higher age is required, will another lottery like this one ever be needed.

Some little question has been raised as to why capsules, instead of a wheel were used. The answer is simple A wheel can get out of order. A draft of air can affect it. A charge, no matter how baseless, could be made that it was tampered with, "fixed" and therefore unfair. The most astute lawyer, the most unscrupulous disturber, could not produce an argument worthy of a moment's attention that anything but absolute chance governed the order in which the numbers were picked from the glass bowl, or even point out a possible way in which this draft could be considered in any way less than absolutely fair.

A Place where Electric Fans are Needed but Cannot be Used

ELECTRIC current for fans is not generally available in Aden, Arabia, and the old-fashioned punkha system is the only relief from the almost unbearable heat and closeness of the atmosphere which prevails at certain seasons of the year. A punkha is a large ceiling fan operated by a coolie who pulls a rope attached to it. This rope generally passes over a small pulley through a hole in the wall, so that the coolie may work unseen by those in the room to be ventilated. Often a series of fans is operated by one coolie, this system prevailing in hotels, clubs, and other places where there is a large space to be cooled. The actual cooling effect is usually considered more satisfactory than that of an electrically-operated fan in the respect that the air currents are more gentle and much more evenly distributed. A punkha-walla, as the coolie who operates it is called, receives in Aden an average wage of $3.50 per month for working from eight to nine hours a day. However, during the hot season when it is desirable to have the punkha in operation night and day a force of three punkha-wallas, working eight hours each, is necessary, and the punkha becomes somewhat expensive. Furthermore, such human labor is obviously neither easily regulated nor dependable in the sense that a machine would be and the punkha-walla would be generally replaced with machine-power fans if they were reasonably available.

While for many years there has been talk of giving Aden a general electric plant, and plans have even been definitely made to that end, the present outlook is not particularly encouraging. Accordingly, there would be a good market there for fans that could be operated without electricity, such for instance as those burning spirits or kerosene to generate power, if they were properly and energetically introduced. A fan of that sort for this market should not be too expensive, although there would be some sale even for fairly expensive apparatus. These fans, if satisfactory, could be sold to the European population with but little effort. The natives would also be good customers, the proportion of them becoming purchasers depending upon the price at which they could be sold. A few individuals have imported fans of this sort from India and Europe, but there is no general use of them, and so far as can be learned no local merchant has seriously attempted their introduction.

Cement from Sugar Beets

EXPERIMENTS in French plants began early in 1917 have resulted in the production of an excellent cement as a by-product of beet sugar refining. The first step in the production of sugar from beets is boiling them. It has heretofore been customary to throw away as valueless the scum formed on the caldrons. But it has now been discovered that this scum contains large quantities of carbonate of lime. It is estimated that 4,000 tons of the carbonate can be recovered from 70,000 tons of beets. To this quantity of the carbonate 1,100 tons of clay are added, the resultant product being a cement which, according to *La Revue* (Paris) is of "perfect quality." The beet scum is pumped into large reservoirs and allowed to evaporate for a certain length of time before being mixed with the clay. It is then stirred or beaten for an hour before being fed into a rotary oven such as is used making Portland cement.

A street kitchen for the relief of earthquake victims

Houses for the poor erected in vacant lots

The Earthquakes and Eruptions in San Salvador

Seismic Disturbances in Central American Republic from June 7th to July 4th, Last

By Herbert J. Spinden, Assistant Curator of Anthropology in the American Museum of Natural History, New York

IN the days following the earthquake and the outpouring of lava from the new vents in San Salvador volcano one received the impression, looking out from the ruined city, that nature was surprisingly tranquil. The sun shone brightly and the piled up masses of clouds were apparently unblemished by smoke streaks. The fuming of the lava could not be seen from this distance and there were no pyrotechnic displays at night after the fatal hour of the first eruption. In the city itself, however, human beings were not so tranquil. Indeed, the feverish hurry of those days can best be compared to that of an ant's nest suddenly overturned. But now that city life has reëstablished itself, somewhat uncomfortably to be sure, the visible activity of the volcano has become spectacular.

Before we enter upon a discussion of causes and effects let us take a brief survey of things as they are, and especially of the wastes of lava and the activities in the new and old craters. The lava flow can be reached easily from Quezaltepeque by riding southwest along the line of the railway and the highway to the Coast or by turning south and climbing the lower slopes of the mountain. It has been estimated by engineers to cover an area of 40 square kilometers to a depth of 10 meters, and to have a volume of 400,000,000 cubic meters. This estimate appears somewhat excessive to the writer, but at any rate a great area of exceedingly rich coffee and maize land has been put out of commission for centuries. The flow extends to the much higher wall of a previous flow, by some persons said to be that of the last previous eruption, which took place in the seventeenth century. The railroad tracks are covered for a distance of ten and a half kilometers and an extensive detour is made necessary to reëstablish communications. The highway is also overrun.

The lava is dead black for the most part. It has the porous, stringy appearance of molasses candy with air bubbles greatly elongated in the direction of the flow. Much of the surface is badly broken, possibly as a result of the heavy rains that fell on the superheated crust, but in many places one still sees clearly the transfixed current where ripples, eddies, cascades and foaming crests are petrified. Through sulfurous breathing holes the internal heat still rises and will doubtless continue to do so for many weeks. The heat waves that dance over the lava make the taking of clear photographs impossible, and in the distance the blue smoke veils the mountain crest.

The crater of the San Salvador volcano

Higher up the mountain side, in the coffee finca Monte Rico, the lava appears to have advanced with greater rapidity, as might be expected from the steeper slope. A ravine is filled brim full, and long arms run out in separate streams from the main mass. The walls of the flow are 30 feet or more in height and are sharply drawn. The lava appears to have caused no conflagration and even trees completely surrounded by it are unburned in several instances. In one place, well within the waste of lava, I observed a giant Cieba around the brink of which the black slabs have piled up like ice above a bridge pier.

The vents from which the lava issued are not especially spectacular. They are great holes surrounded with slabs of lava too hot to be crossed. They extend in a line down the mountain and are in all probability located along a fissure. According to some persons these vents are not entirely new. An earlier flow apparently had its source near by. The new craters are close to a hill known as Jabali but whether or not this is a volcanic cone I am not able to say. The highest vent appears to be well under the bottom of the old crater.

The old crater of San Salvador Volcano began to show signs of activity only after the lava had flowed out from the new fissure. It is now giving off a vast quantity of steam that rolls upward like a cumulus cloud. The rim of the old crater stands about four thousand feet above the city and the ride to it is one of much interest. The green valley, beyond which lies the beautiful lake of Ilopango, spreads itself out like a map as the trail winds higher and higher through ruined and leafless plantations of coffee. A last short climb and you stand on the edge of a crater over a mile in diameter and a thousand feet in depth. Formerly a green lake filled the bottom of the crater and green trees and shrubs clung to the steep walls. Now the brown leaves are silvered over with volcanic dust and only three pools of violently agitated water remain near the old time margin of the lake. For days the lake boiled furiously, with a fountain in the middle, then a black mass of cinders and lava was seen to force itself spasmodically above the water. Now in the dusty center of the dried up lake bed opens an orifice like the mouth of a great tube, and a black geyser of cinders shoots upward at intervals. The black geyser is a pulsating spray of cinders and slabs of lava. When this black geyser has forced itself to the height of

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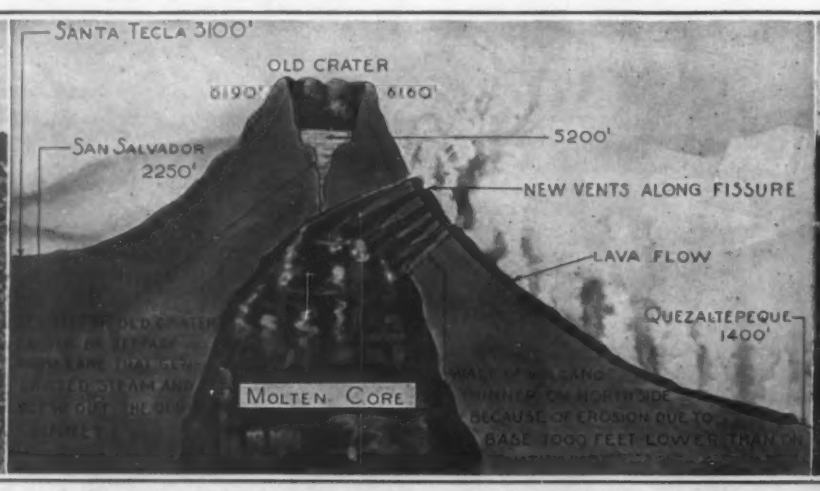
Railroad blocked by thirty feet of lava



Sectional view of the San Salvador volcano, showing what happened and how

Where the lava has blocked the road

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

An Engineering Chimera

To the Editor of the SCIENTIFIC AMERICAN:

In the article on the proposed Highway Tunnel beneath the Hudson River in your issue of January 13th, you refer to the ventilation difficulties that might be encountered in such a tunnel. I believe that these difficulties have been grossly underestimated, and that adequate ventilation is wholly out of the question. The computations are simple, and while the scientific assumptions underlying the matter are not on a basis of complete certainty, they appear to be sufficiently definite to make possible clear conclusions.

Tests by Marks, Schröter, Robinson, Price and the Automobile Club of America, made independently and on engines of many types, give figures for gasoline consumption per horse-power-hour, ranging from .6 to 1.04 pound. Since the reduced speed necessary in such a tunnel as that proposed makes for loss of efficiency and increase of fuel consumption, we may without fear of overstating our case take the average of these figures, which works out .75 pound per horse-power-hour.

Your own motor truck editor, Pagé, has fixed the amount of air necessary for the combustion of a pound of gasoline at 16 pounds, a figure in good accord with those given by others. We have then 17 pounds of exhaust gases, which are given off at a temperature of about 600° Fahrenheit. If we assume that the mixture is of substantially the same density as the air itself, and that its permanent temperature while it remains in the tunnel is some eighty-odd degrees—certainly this leaves us well within the facts—the 17 pounds will occupy something like 234 cubic feet. So we have exhaust gases about 175 cubic feet in volume per horse-power-hour.

These gases contain both carbon dioxide and carbon monoxide. Authorities differ as to how much of each may be expected. Clerk, Schröter and Robinson give from 9.9 to 13.8 per cent CO_2, with an averaged statement of 11 per cent. Working the thing out by chemical formula on the hypothesis of perfect combustion supports this figure.

Perfect combustion, however, is never attained; and it is this fact that leads to the presence of CO in the exhaust. Clerk finds this insidious poison in a ratio ranging from 2.4 to 6.9 per cent of the total volume of the exhaust. The Royal Automobile Club tested 12 cars and obtained four results below two per cent and eight above that figure, exact values not stated. Reliable observers have reported as high as 15 per cent CO. An elaborate series of tests made for the Public Service Corporation in connection with the present tunnel project showed invaraibly more CO than CO_2 in air vitiated by the operation of motor vehicles. The same chemical calculation already mentioned shows that this occurs when the dioxide content falls to 6½ per cent or less of the exhaust and the monoxide rises to 7½ per cent or more. All things considered, it would seem that an estimate of 7 per cent monoxide would certainly be a reasonable minimum.

We may safely take the average horse-power of all cars using the tunnel as 15. Then we have 2,625 cubic feet of exhaust gases per car per hour, or 44 cubic feet per car per minute. Ignoring all other impurities, this gives rise to 3 cubic feet of CO per car per minute. It is contemplated that vehicles pass in a double line under 60-foot headway throughout the 5,500-foot length of the under-river section of the tunnel. Hence there would be 180 vehicles in the tunnel at once, generating 540 cubic feet of carbon monoxide per minute.

Air in the tunnel must under all circumstances be bad, in comparison with outdoor air. Moreover, there will be many occasions when the proper headway will not be observed. And in all our estimates we have been very conservative indeed. There seems no more reason for omitting the factor of safety here than in any other engineering proposition, especially since we shall otherwise ignore the generation of carbon dioxide and marsh gas in the tunnel. So let us add 33⅓ per cent—a very moderate safety factor—and agree that we must be prepared to meet the generation in our tunnel of 720 cubic feet of monoxide per minute. We must do this by ventilation; we must ask how fast it is necessary to introduce fresh air into the tunnel to keep the monoxide at a safe dilution. This in turn involves determination of the safety limit in CO content.

Here is where I find the most glaring error in the report which sets forth the tunnel's feasibility. Haldane has pronounced 0.1 per cent of CO to be dangerous, with recovery possible, 0.2 per cent to lead to unconsciousness, 0.3 per cent to be rapidly fatal. Glaister's monumental treatise on gas poisoning devotes over three hundred pages to the effects of carbon monoxide, discussing the many serious diseases—arteriosclerosis, paralysis, pneumonia, insanity, etc.—of which it is a direct cause. Carpenter tells us that 0.06 per cent brings on suffocation in 47 minutes, 0.12 per cent poisoning in 7 minutes, and 0.29 per cent death from convulsions in 2 minutes.

It follows from all this that we have to do, not merely with determining the percentage of CO which will certainly prove fatal, but with stating a figure beyond which considerations of health will not permit monoxide pollution of the air to go. Yet the prospective builders of this tunnel merely find that while 0.58 per cent of CO is "dangerous to breathe for 15 minutes" (perhaps they meant "fatal" and "15 seconds"), and while 0.43 per cent is "also dangerous to breathe for 15 minutes," 0.2 per cent is merely "unpleasant and dangerous to breathe for 30 minutes," 0.15 per cent is "dangerous to persons physiologically weak or susceptible to CO who breathe it for 30 minutes," and with 0.075 per cent of CO the "atmosphere is almost normal and the content not dangerous."

The state of mind revealed by these findings would be bad enough, even if the company engineers were willing to take their own results at face value and so ventilate the tunnel that the monoxide content should be at most 0.075 per cent. Even this, however, is far from the case. They calmly ignore these results and conclude that while "some investigations carried on by the Bureau of Mines in the Department of the Interior have apparently given some support to the view" that CO in the air should be diluted to the extent of at least 1,000 parts fresh air to one of the poison, "it has not yet been clearly established that a much less dilution will not accomplish all that is desired!" Accordingly, in the absence of what they are willing to recognize as direct proof to the contrary, they assume that with a dilution of 500 parts fresh air to one of carbon monoxide—with the 0.2 per cent CO content which they themselves recognize as unpleasant and dangerous to breathe for 30 minutes, which Haldane asserts leads to unconsciousness, and which the Bureau of Mines puts at double the very worst monoxide pollution that can be supported—with such dilution, they assume that their customers will come up out of the tunnel alive, that this is all that is necessary, and that consequently such ventilation will fill the bill.

This, of course, is quite out of the question. In view of all the findings which I have detailed, in view of the facts that the legal limit of CO_2 in 21 states is 0.1 per cent, and in 10 states 0.07 per cent, while CO is a poison many times more deadly than the dioxide, I do not see that it is possible to consider as satisfactory any proposition which involves dilution of the monoxide in the tunnel with less than 2,000 parts fresh air to one of the poison. Ventilation, in other words, must reduce the monoxide content of the tunnel atmosphere to 0.05 per cent. For one thing, it is certain that with ventilation currents and eddies, with badly operated cars, with air currents caused by the traffic, with traffic tie-ups and traffic congestion, with carbon monoxide slightly lighter than air and carbon dioxide somewhat heavier—with all these complications, it is certain that diffusion will not be perfect, that no matter what degree of attenuation of the CO is adopted, there will constantly be places in the tunnel where that degree is notably exceeded. It is even possible that 0.05 per cent CO in the entire tunnel might not be safe; certainly no greater proportion would be so.

With an elliptical cross-section of 32½ by 22½ feet, the sectional area of the tunnel is something like 575 square feet, and the volume of the 5,500-foot bore between the main shafts is 3,160,000 cubic feet. At 0.1 per cent we must recognize that the CO content begins to be *immediately* dangerous. But at the rate of 720 cubic feet per minute, it would be only four minutes after the tunnel began to be operated at full capacity before this condition would be reached, provided there were no ventilation at all. In less than an hour the tunnel air would contain 1 per cent monoxide, which of course would be instantly fatal.

It is then in order to see what is involved in adequate ventilation. To supply 2,000 volumes of fresh air to one of monoxide would entail the introduction into the tunnel of $2000 \times 720 = 1{,}440{,}000$ cubic feet of air per minute. It is proposed to have a duct with a section of 52 square feet, and to admit one-half the air at each shaft. The required velocity of air in the duct would then be $720{,}000 \div 52 = 13{,}800$ feet per minute, or 160 miles per hour! This (Kent, p. 531) would necessitate the use of 32,000 horse-power. Adding 50 per cent for the approach tunnels gives 48,000 horse-power for the entire ventilation scheme. At an annual cost of $50 per horse-power this would come to $2,400,000. It is not necessary to state that this is equivalent to interest at 5 per cent on $48,000,000 in order to make it plain that such an absurd charge could not possibly be borne.

Even if we are to give these gentlemen the benefit of every doubt, and concede the possibility of ventilation, using the tunnel bore itself as a duct—a risky engineering proposition, at best—the matter is not greatly improved. We must now admit all our air at one end and pass it through to the other shaft; and to do this we must fill the tunnel with a blast of wind blowing approximately thirty miles per hour! Even so, the cost is still prohibitive, to say nothing of other obvious drawbacks.

Accordingly, I reach the conclusion that a tunnel beneath the Hudson River for motor traffic is an engineering impossibility. For trolleys, for electric or steam trains, even for horse-drawn vehicles and for pedestrians, yes; in every one of these cases a tunnel is the logical solution or at least a logical solution of the problem presented by New York's stubborn watery barricade. But if automobiles and motor trucks cannot be accommodated on the ferries, they must have a bridge. And in this connection I would point out that two, if not three, bridges could be built with the capitalized cost of ventilating one tunnel—without reference to construction costs and other operating expenses.

NEW YORKER.

Submarine Observations

To the Editor of the SCIENTIFIC AMERICAN:

I have read with interest several articles recently published by you on the subject of shielding vessels from torpedoes.

To a civil engineer the construction of suitable floating shields to be secured to a vessel to ward off or explode torpedoes seems like a simple matter. The writer has submitted several such schemes to Government engineers but has found in each case that the construction was of doubtful utility because of the impractical management of the ship and of the shield in heavy seas.

It is comparatively easy to invent when one is not handicapped with too intimate a knowledge of the subject he is tackling. This is the reason why the writer and others have helped fill the Patent Office. However, the public cannot expect us to sit idle and afraid to open our mouths with daily sinkings and submarines increasing. Up to the present, the steamship has relied on immunity from attack by means of maneuverings intended to evade the submarine. Numerous public statements have been made that methods have been discovered for combating the submarine. Now, if any of these rumors be true, then it would seem to the writer that the time has come to adopt an entirely new method of handling vessels and of combating the submarines. That is, instead of avoiding the submarine with the ships and hunting her all over with the chasers, compel her to come where you are prepared to handle her.

One way of doing this is convoying the vessels in flotilla style, preceded by mine sweepers, each flank protected with floating shields drawn along independently and at sufficient distance away from the outside ships to be safe. Then with all the paraphernalia for combating submarines, proceed on a regular course. The submarines would either have to let you pass unharmed or swarm around and attempt attacks. If we are prepared to meet them on our own ground then this method would quickly settle the issue. If we have no means of combating them then we will have to continue the dodging and uncertain method now in vogue.

GUY B. WAITE.

New York.

Canvas Shields for Ships

To the Editor of the SCIENTIFIC AMERICAN:

After reading Maxim's elaborate scheme for protecting ships from the effects of torpedo explosions, I am led to suggest the following devices:

1. Canvas strips or sheets carried folded along the rail of the ship.

2. Ropes attached thereto and carried through pulleys and thence to electric motors, in such manner that pressing a button will cause the particular sheet desired to be drawn down into position below the water line so as to cover the shattered portion of the hull, to diminish the ingress of water.

SAM. M. HYNEMAN.

Columbus, O.

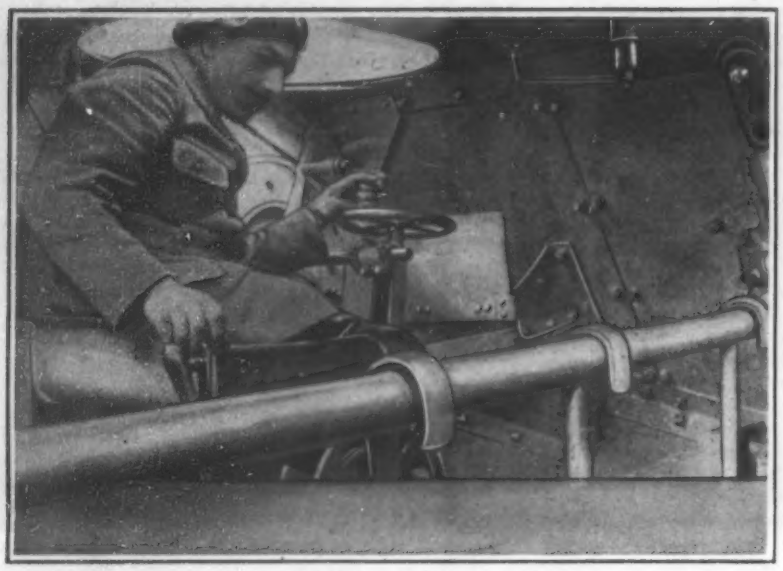
Nets to Protect Merchant Ships

To the Editor of the SCIENTIFIC AMERICAN:

Will you kindly tell me what there is impractical about the idea of protecting merchant ships in transit from submarine torpedoes by means of nets of sufficient strength, proper depth and right mesh to either stop, divert or entangle the propeller of the torpedo. If it were not practical for each ship to carry its own nets far enough away from the sides to afford protection, then the nets might be towed by smaller boats in the lead. A whole fleet might be thus protected, or each ship except the leading one could be protected by nets towed by the one ahead. I can hardly imagine that this idea is brand new yet I have never seen it mentioned in any of the papers or magazines.

J. H. ARNOLD.

[The plan of protecting warships by suspending nets at a distance from their sides is old. They are effective when ships are at anchor or moving at very slow speed. At higher speeds the nets would be carried to the surface and cease to be effective.—EDITOR.]



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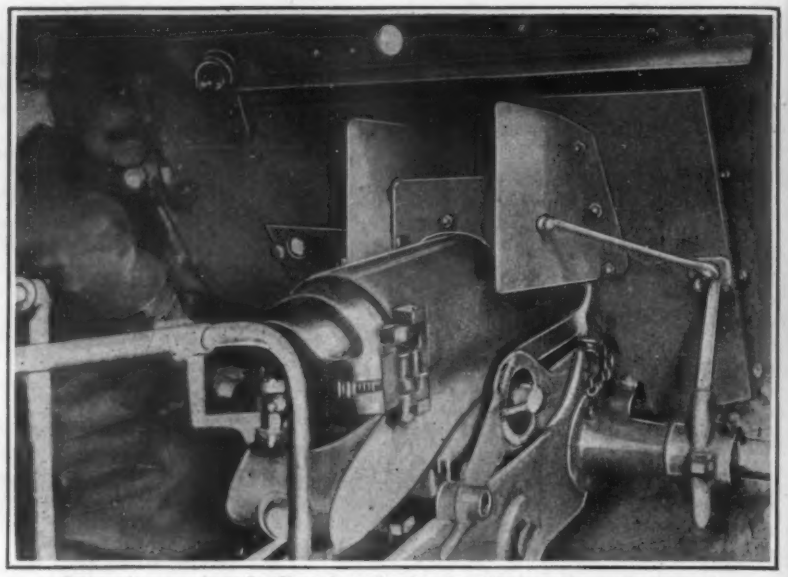

Gunner's post aboard a French tank, showing the breech mechanism of the 75-millimeter quick-firing piece

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At about the same time that the British began the construction of their land fleet or "tanks," the French also started on similar work. But it was the British who first made use of these novel weapons during the battle of the Somme, and thus gained title to the invention of the tank. Meanwhile the French held back their land fleet; some say that they were rather dubious of the possibilities of such radical weapons, and preferred to await the results achieved by their British counterparts, while others claim that the French tanks were not ready in time to participate in the battle of the Somme. At any rate, while the latter claim is probably nearer to the truth, the fact remains that the French land ships made their initial appearance on the field of battle on April 16th last, during the great offensive of General Nivelle's forces.

The first French tanks to see action were of small size and of radically different design from the British, although in principle they were the same; that is to say, they consisted of heavily armored cars equipped with machine guns and quick-firing pieces, and propelled by caterpillar tractor belts driven by heavy-duty internal combustion engines. As for shape, the French tanks were not so fantastic as the British, being more along the lines of a square steel box, terminating in front in a ship-like bow and a slanting steel cutting member. The quick-firing pieces of the French tanks were probably short-range field guns firing a three-inch shrapnel or high-explosive shell.

The original French tank has been eclipsed by a larger and more powerful tank which made its debut on May 5th, during the second great offensive of the year to be undertaken by the French forces, in which Craonne plateau was captured. This tank is known as the St. Chamond type, and while it retains the general outline of the smaller one, it is a far more powerful machine. As an additional feature, it is provided with three turrets well up towards the front, as well as a long-range quick-firing cannon which protrudes through a porthole in front, slightly to one side of the center line. The bow-shaped front is retained in the St. Chamond model, although the slanting steel outrigger appears to have been curtailed. Access is gained to the interior of this steel leviathan through one or the other of the turrets which are provided with hinged tops. Because of the large surface of the caterpillar tractor belts, which comes in contact with the ground, as well as the potency of its engine, the new tank has remarkable power; indeed, it is capable of over-riding practically any battlefield obstacle. As a test of its power a tank of this type was recently driven through a dense wood, and it made its way without any appreciable delay, leaving in its wake a trail of crushed and broken trees.

As the first pictures of their kind the accompanying illustrations are of considerable interest, especially those of the interior of the St. Chamond tank. The first impression one gains upon examining these views is that the tank, not unlike the submarine, is a veritable maze of levers and pipes and gages and control wheels. And this is precisely correct; for the interior of a land ship is given over entirely to the power plant and the armament. It is due to this lack of space and air that the crew of a tank is greatly discomforted during an engagement; but for this there is no ready remedy.

Piloted by skilled and intrepid crews, the large tanks, or *artillerie d'assault* as the French call them, proved of considerable aid to the attacking infantry during the last offensive operations, according to official reports. These mobile forts, lumbering and lurching along at

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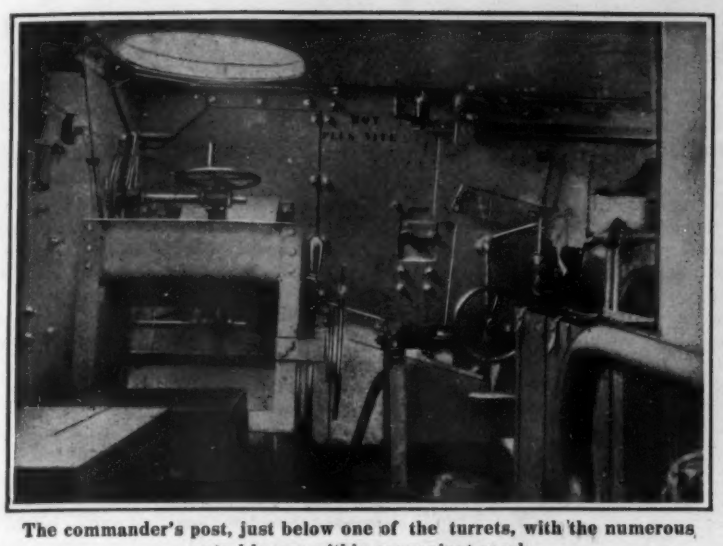

The commander's post, just below one of the turrets, with the numerous control levers within convenient reach

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A squadron of the original small French tanks maneuvering over the shell-torn terrain of a battlefield

a speed between three and five miles an hour, had no difficulty in negotiating terrain naturally difficult and made even more so by innumerable shell holes and artificial obstacles, all the while keeping some distance ahead of the infantry waves advancing to the attack.

(Concluded on page 90)

A Quick-Firing Cannon Which Advances with the Skirmishers

IN order to combat the German machine guns the French of late have introduced in their army a new quick-firing cannon of such construction that it can be readily carried forward by attacking infantry. Thus the skirmishers are able to put enemy machine guns out of action by well-directed shots from their 37-millimeter cannon, which they can carry along with them.

The French "37" is a befitting companion to the famous "75," which has figured so prominently in the French campaigns to date. It will be noted in the accompanying illustration that the smaller weapon has every feature of its larger brother, including quick-acting breech mechanism, accurate sights and automatic recoil. Lying out on open ground the crew of two men can fire up to 35 high-explosive shells per minute. The shells measure almost 1½ inch in diameter, and the gun has a range well above a mile for accurate shooting. This odd little field piece can be readily taken apart and carried by six or eight men, and is available for use in advanced positions as well as in the open. It is a most workmanlike piece of armament for use under the conditions prevailing on the Western front.

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French colonial troops operating a 37-millimeter field piece which is designed to destroy enemy machine guns

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Coal at Thirty Cents a Ton

THE coal problem is a serious one to property owners, steamship companies, railroads, manufacturers—to everyone in fact, except a certain lawyer in Norton, Va., who found a mine in his cellar recently. Though coal go to eighteen dollars a ton, as predicted, this favorite of fortune will be able to mine his coal direct from his cellar at the very reasonable sum of 30 cents a ton! And it is good coal, too. It is of high calorific value and there is enough of it in sight to last the lawyer, his children and their grandchildren for the rest of their natural lives.

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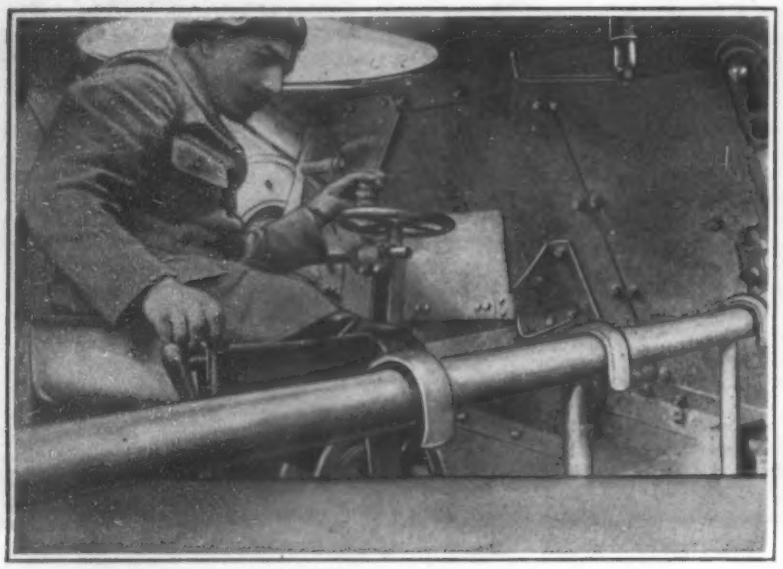

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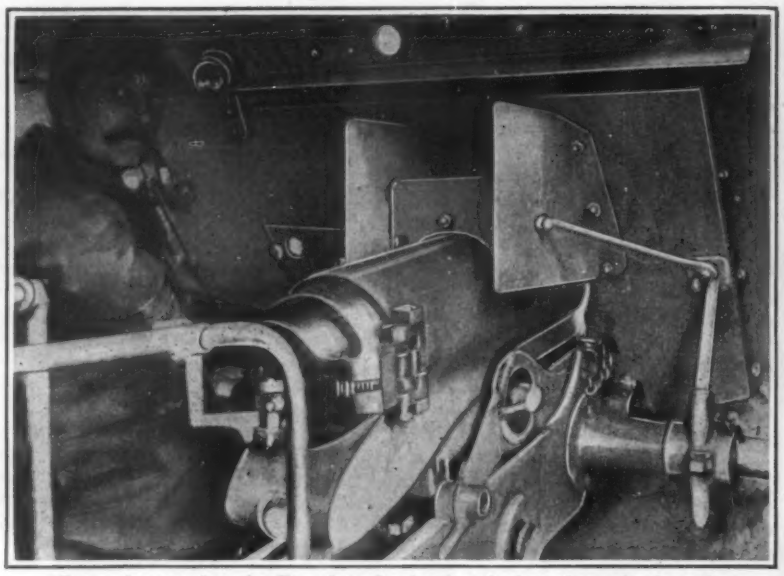

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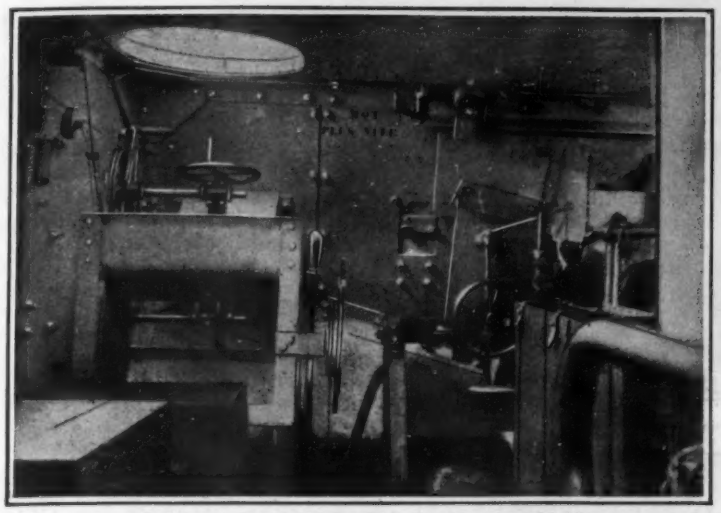

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The Heavens in August

Star Velocities: Some of the Aspects of This Interesting Problem

By Henry Norris Russell, Ph.D.

ONE of the most interesting of the scientific papers of the past month comes from Mount Wilson. It merits discussion here for two reasons—the interest of its contents, and the excellent example which it affords of the complexity of some of the problems of modern astronomy.

One of the things which astronomers have been anxious for many years past to determine is the average velocity with which the stars are moving in space. A knowledge of this is not only important in itself, but it is of great value in enabling us to estimate the average distance of the remote stars. We can find, by observation, how fast these stars *appear to be moving* across the heavens (in seconds of arc per year), and, also, with the spectroscope, how fast *they are actually moving* toward or from us (in kilometers per second). On the very reasonable assumption that the average rates of motion of the stars in the two directions concerned are substantially equal, we can find at once the distance at which a star, moving at right angles to the line of sight, with the actual average speed derived from the spectroscopic data, would appear to travel over the heavens with the "proper motion" equal to the average observed value. This distance will give us a good idea of the average distance of the stars of one group, though some, of course, will be nearer, and others much more remote.

The fact that we observe the motions of the stars, not from a fixed point, but from a system which is itself in motion, complicates the problem a little. But, when once the direction and rate of motion of one solar system are known, it is an easy matter to calculate just how much these influence the observed rate of approach or recession of a star, and correct our observations accordingly. The corrected value is called the "peculiar radial velocity" of a star, since it is an individual peculiarity of each star.

As for the apparent motions of the stars in the heavens, we know that, if they were really at rest in space, the motion of our system would cause them to appear to drift across the sky, away from a certain point, called the "solar apex," and toward the opposite point, at a rate which would be the more rapid the nearer the star.

The actual motions of the stars in the sky at right angles to the direction of this drift are evidently unaffected by the motion of the solar system, and it is the average amount of these motions, which, for convenience, we may here call the "cross motions," which ought, on the average, to be equal to the average of the peculiar radial velocities.

Having now learned something of the nature of the problem, and of the meaning of the terms which must be employed in discussing it, we may describe the results of observation.

As long ago as 1900, Campbell, at the Lick Observatory, having determined the radial velocities of 280 stars, and from these the motion of the solar system, found that the average remaining peculiar radial velocity of these stars was 17 kilometers per second.

But on taking averages separately for the brighter and fainter stars (that is, for those which would appear bright or faint on a direct photograph of the sky), he found that the average motion of the fainter stars appeared to be very decidedly more rapid than that of the brighter ones. With true scientific caution, he refrained from any attempt at explanation until more observational material was available, and set to work hard to obtain this, as did other observers also.

This caution proved well-founded, for in a few years evidence began to appear that the main factor in the differences between the average rates of motion of different groups of stars was not their *brightness*, as it appeared to the eye or on the photograph, but their *color* (or to speak technically, their *spectral type*, for the colors of the stars are very closely associated with the lines which appear in their spectra—both being probably determined by the *temperature* of the star).

Frost and Adams at the Yerkes Observatory, found that the whitest and hottest stars of all—such as occur predominantly in the constellation Orion, and are therefore often spoken of as the "Orion type"—were moving very much more slowly, their perculiar velocities averaging only 7 kilometers per second. Later researches by Campbell showed that there was a steady increase in the average speeds of the stars from one spectral class to the next, from about 6 kilometers per second for the whitest stars to 17 for the reddest. Almost at the same time, these results were confirmed in a very striking fashion by the independent work of Boss, who used an altogether different method of study. It now seemed that it was the hotter and whiter stars that were moving slowly, and the redder and cooler ones that were going fast—and many were the attempts made to explain why this should be the case, with little success.

Campbell's original observation, however, proved easily explicable. Since he grouped his stars by their photographic brightness, and since red stars photograph faint, most of the fast-moving red stars in his list got into the fainter groups, and most of the slowly moving white stars into the brighter groups; hence the average speed was greater for the fainter stars, not because they were faint, but because more of them were red. When the stars of the *same* color were grouped according to apparent brightness, it was found that there was very little, if any difference between the average rate of motion of the brighter and fainter ones, but a marked difference between the speeds of stars of the same apparent brightness but of different colors.

Nevertheless, still fuller evidence now indicates strongly that the average velocities of the stars do depend on their brightness after all; but on the *real* brightness, compared with the Sun, and not the *apparent* brightness which they exhibit in the sky, and which depends largely upon their distances from us.

This was strongly indicated by the work of Kapteyn and Adams some years ago, and appears now to be conclusively proved by a paper by Adams and Strömberg of Mount Wilson, to which reference was made at the beginning.

With the aid of the very remarkable spectroscopic method of determining the absolute brightness of the stars, devised a few years ago by Dr. Adams, and by other ingenious methods, the real brightness and the real motions in space, in the directions of both the radial and the cross velocity, have been determined for about one thousand three hundred stars, of the redder spectral classes, ranging from stars like Canopus, which are probably considerably hotter than the Sun, to those like Antares which are much cooler.

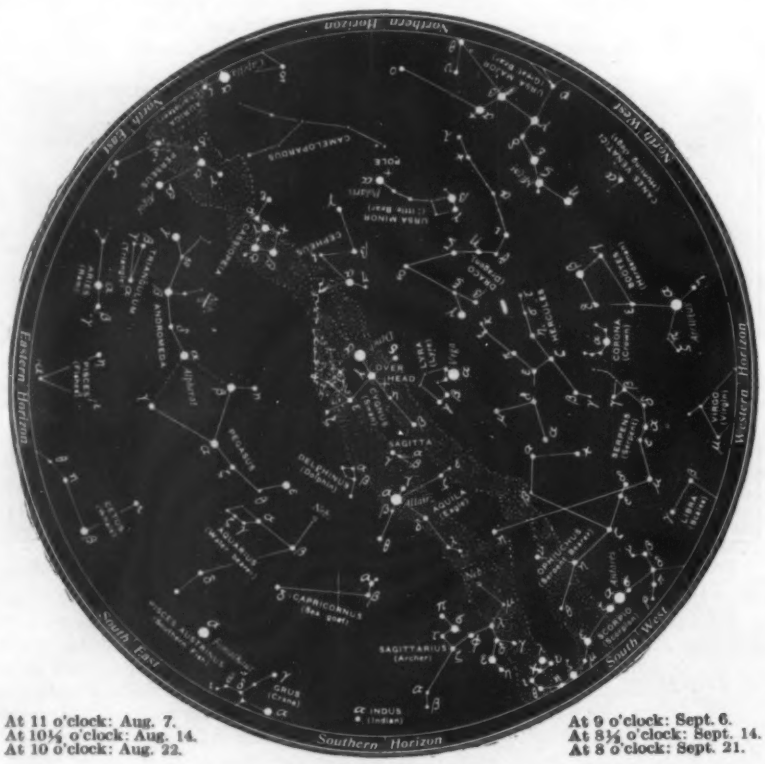
By suitable groupings of these stars it was found that stars of the same color and the same real brightness, whether near us in space or very remote, had substantially the same average velocity. But stars of the same color and of different real brightness are moving at decidedly different rates, and the faintest stars have the highest speeds. Thus, among the redder stars, a star 100 times as bright as the Sun, has on the average, a velocity of 14 kilometers per second; one equal to the Sun in brightness, about 22 kilometers, and one 100 times fainter than the Sun, an average speed of 30 kilometers. The yellow and yellowish stars, which resemble the sun in temperature, are moving a little more slowly, for the same absolute brightness, but the difference is small compared with the great difference between the speeds of stars of the same temperature but of different brightness.

Now this has a very interesting bearing upon the difference in the average rates of motion of the stars of different colors and temperatures. For the very hot stars of the Orion type are, as might be expected, all of very great brightness—averaging probably five hundred times as bright as the Sun, and with such great brightness we would expect slow motion among the stars of any color or spectrum. On the other hand, practically all the really faint stars—say those less than one-tenth as bright as the Sun—are orange and red, and these stars are moving very rapidly, and bring up the average for the whole group of the redder stars.

A considerable part of the difference between the average speeds of the white and red stars is probably explicable in this way—though apparently not the whole of it.

After reading this long story one is naturally moved to ask: What is behind all this? We supposed at first that it was the stars which looked bright to us which were moving slowly; then the hot stars; at present the stars which are actually very bright in comparison with the Sun. But why should hot stars or bright stars move faster or slower than cool or faint stars?

It obviously would be over-bold to try to give a final answer; indeed, there may still be more to learn about the facts, as the history of the case suggests. But, from what we already know about the stars, it is very probable that only large masses of matter ever shine very brightly or get very hot, while the small ones, if they shine at all, are faint and relatively cool. So it looks as if the physical fact behind the observations was that the heavy, massive stars move slowly, and those of small mass move more rapidly. To any physicist, such an arrangement appears reasonable; and, though we cannot explain yet just how it might come about, there is good reason to hope that an explanation may soon be found.



At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.
At 9½ o'clock: Aug. 29.
At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

Night Sky: August and September

The Stars for the Month

Turning now to our map of the heavens we find the great cross of Cygnus right overhead—its standard stretching from northeast to southwest along the Milky Way. Below it, almost due south, is Aquila with the bright star Altair; and below this, a little to the right, is Sagittarius, west of which is Scorpio, just setting.

The southeastern sky is very dull, the only prominent star being Fomalhaut in the Southern Fish, between which and Aquila are the inconspicuous groups of Capricornus and Aquarius.

The great square of Pegasus is prominent in the east. To the left comes Andromeda, then Perseus and Cassiopeia, in the Milky Way. In the northwest are the Great Bear, low down, and the Little Bear and Dragon above, while Boötes, Hercules and Ophiuchus are in the western sky, with Lyra above them, and nearly overhead.

The Planets

Mercury is an evening star this month, but is unfavorably placed, being south of the Sun, so that, even at the time of his elongation on the 23d, he sets at 7.40 P. M., only an hour after the Sun, and is deep in the twilight.

Venus is also an evening star, a little farther from the Sun than Mercury; but, being so much brighter, she will be easy to see.

Mars is in Gemini and rises about 2 A. M. in the middle of the month. He is still 200,000,000 miles away. and appears a little fainter than Castor or Pollux.

Jupiter is a morning star in Taurus, rising about 12.30 A. M. on the 1st, and as early as 10.45 P. M. on the 31st.

Saturn is in Cancer just past conjunction with the Sun, and is invisible.

Uranus is in opposition on the 15th, and is well observable. He is in the eastern part of Capricornus, his position on July 30th being 21h. 39m. 52s.—14° 47′, and on August 31st 21h. 34m. 57s.—15° 11′. On the 27th he is 1° 53′ due north from the fourth magnitude star γ Capricorni.

(*Concluded on page 91*)

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

A Gasoline Motor Corn Cultivator

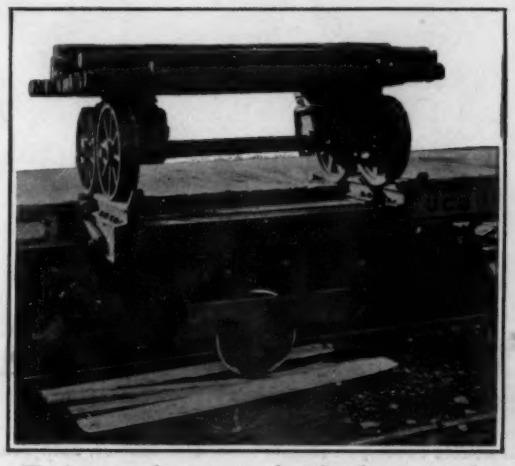
By Frank C. Perkins

THE accompanying illustration shows a novel motor corn cultivator developed at Peoria, Ill. It is a two-row cultivator with motor of the machine placed on the frame near the front. It has heavy duty bearings and the cylinders are cast *en bloc*, with removable cylinder head. The cooling is assisted by means of a radiator placed in front of the motor. The four-cylinder, four-cycle, vertical motor has three-inch bore and four-inch stroke. The wheelbase is 84 inches and both rear wheels are drive wheels and are 42 inches high, with a six-inch face.

There are angle-iron cleats provided which can be quickly attached or detached, so that perfect traction can be secured in all conditions of ground. The main feature about this motor corn cultivator is that the two drive wheels are operated separately by means of a friction drive transmission. Each of the drive wheels is easily controlled by the operator, who sits behind the entire machine, and the mechanism is such that one wheel can be held stationary while the other travels forward or backward at the same time. In order to further facilitate turning around in this manner at the end of a row of corn in order to go up the next row, all the operator has to do is to throw out the gear connection in the steering apparatus and the front wheel will then act as a castor. Then by operating the rear wheels as previously described, the machine can be made to turn completely around in its entire length, as the center of the circle circumscribed would coincide with the wheel that is held stationary.

It is pointed out that the spark and throttle levers are near the steering wheel, within easy reach of the operator, while the moving of the cultivator gangs is operated by the driver's feet, in the same way as it is done on all cultivators. In driving down a row of corn, the gear in the steering mechanism is thrown in and the operator keeps the machine straight in its course by means of the steering wheel. This machine has been tried out in the field and all tests have been very successful, the machine being under easy control of the operator at all times in practically all conditions of farm ground. The machine has a speed of about one-half to three miles per hour when in operation. It operates on gasoline and the fuel is carried in a tank placed above the motor.

A motor cultivator that turns around where it stands



The home-made apparatus for trimming a concrete pavement to a straight edge

An Improvised Machine for Trimming Concrete Pavement

IN connection with the rebuilding of a Bridgeport, Conn., car line it was necessary to trim off a 16,000-foot stretch of monolithic pavement to an unbroken straight edge alongside the track. Faced by the prospect of employing a gang of 25 men with picks and shovels on this work, the company's superintendent demonstrated that necessity is indeed the mother of invention. Using only standard equipment, he put together a machine that accomplished the work cheaply, rapidly, and with complete satisfaction.

The business end of this home-made apparatus consisted of a cutting wheel about twenty inches in diameter, similar in construction to a glass-cutter. The heavy iron frame carrying this wheel was hinged to the side of a single-truck flat trailer so that it would follow the uneven surface of the pavement. In order to make the wheel bite, additional weight had to be supplied directly above it. This was accomplished by laying a track across the trailer car, and out on top of the frame of the cutter; and onto this was run a small truck carrying two tons of old axles. The entire cost of this outfit was a dollar and a quarter, and it cut the unusually heavy pavement with complete success.

By placing the dishes in the tray and into this washing machine, and moving the lever back and forth a number of times, the family dishes are washed in five minutes

Washing Those Dishes

AT last inventive genius has turned its attention to the tiresome problem of dishwashing in the home, and has perfected a machine that is practical, and really saves time and drudgery.

The mechanism is very simple, making for easy operation and sanitation. It consists of a container, funnel-shaped at the bottom, resting on wall supports or on a portable base.

This container is made of heavy metal which will not rust (with reasonable care) and will not discolor. It is perfectly open being free from pockets or perforations that would collect grease or particles of food. In its funnel-shaped bottom is the "dasher" which throws a volume of water from the bottom upward in a slanting direction against all the dishes.

The trays or racks are specially arranged so that the dishes are held in the proper position to get the benefit of this spray of water. There are two of these trays, one above the other. The lower one contains all the larger dishes such as plates, pitchers, vegetable dishes, etc., with a compartment in the center for silverware. The upper tray holds the cups and glasses. The trays are fitted with handles so that they can be lifted easily from the machine to the table. About the same amount of water is required to wash the dishes in this manner as by hand. After using a washing water containing soap, very hot water is put in and the dishes thoroughly rinsed, and immediately set to drain.

Where electricity is used there is no work in operating the dasher. The hand machine is worked by a lever for less than five minutes, and the work is done. The advantage of having the hand machine is that farmers' homes or any household where electricity is not in use, can have the benefit of this labor-saving device.

On the farm the dish-washing machine may also be used for washing eggs, and for this it has been found most efficient.

The Current Supplement

OF all the problems presented to us by the heavenly bodies none is of more absorbing and ever present interest than that of the conditions existing upon the planets. Naturally, our theories and deductions are apt to be based on the conditions that exist on the only planet of which we have any intimate knowledge, the Earth: but our instruments of observation have long since told us that geographical and physical conditions are so different on the other planets that earthly conditions form but a slight basis for comparison. In the article on *Conditions of the Moon* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2170, for August 4th, is discussed the possibility of the existence of glaciers on that planet and reviews the evidence at our command. *An Amateur's Observatory* describes quite an elaborate establishment, but one that is within the means of many an amateur astronomer, and shows plans of the arrangement and construction of that part of the building devoted to the instruments, together with views of the house itself. The fifth lecture on *The Electrical Properties of Gases*, by Sir J. J. Thomson, appears in this issue. *Motorcycle Machine-Gun Batteries* gives a few facts relating to an important branch of the armies of Europe, and is accompanied by several excellent illustrations showing the activities of one of our volunteer organizations that has been preparing for service for the past year. *Workers in Compressed Air* is an interesting story of the conditions under which the tunnels under the waters adjacent to New York, in connection with the new subways, are built. It is illustrated by two sketches of apparatus employed. *Shall We Eat Corn Meal?* contains some valuable information in relation to a food product of special interest to people of America. *Avoiding Collisions at Sea* describes a method for preventing one of the greatest dangers incident to the navigation of the seas. It is illustrated by several descriptive diagrams. *A Workshop Method of Determining the Refractive Index of a Block of Glass, of Which only One Face is Polished* is a short article of value to the practical optician, and is accompanied by diagrams. *The Wireless Storm Detector* tells how an important problem connected with the operation of electric lighting stations is met. *Some Birds of the Yellowstone* tells of some unusual specimens seldom observed by travelers and contains much information of interest to all lovers of nature.

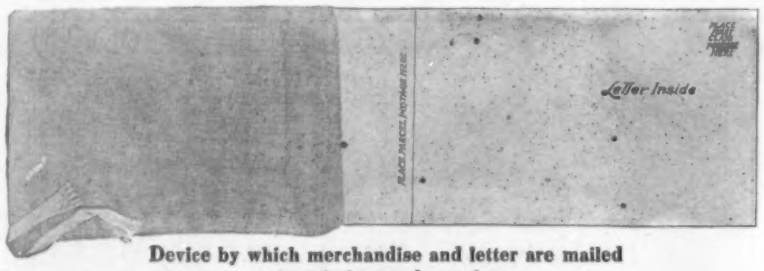
"Under Separate Cover"

RARE indeed is the man who has never had occasion to swear at this phrase. Important pieces of second-class mail matter are shunted leisurely from department to department, seeking their lawful claimant, who some time last week received a letter notifying him of their forwarding "under separate cover," and is now raging over their non-receipt. By great good luck some of them reach their destination and get the proper attention; others go permanently astray, and no man dare guess how many of them are filed away in the waste basket by office boys and mail clerks, along with the worthless material that richly deserves that fate. All of us have at one time or another suffered this inconvenience, either in our incoming or our outgoing mail.

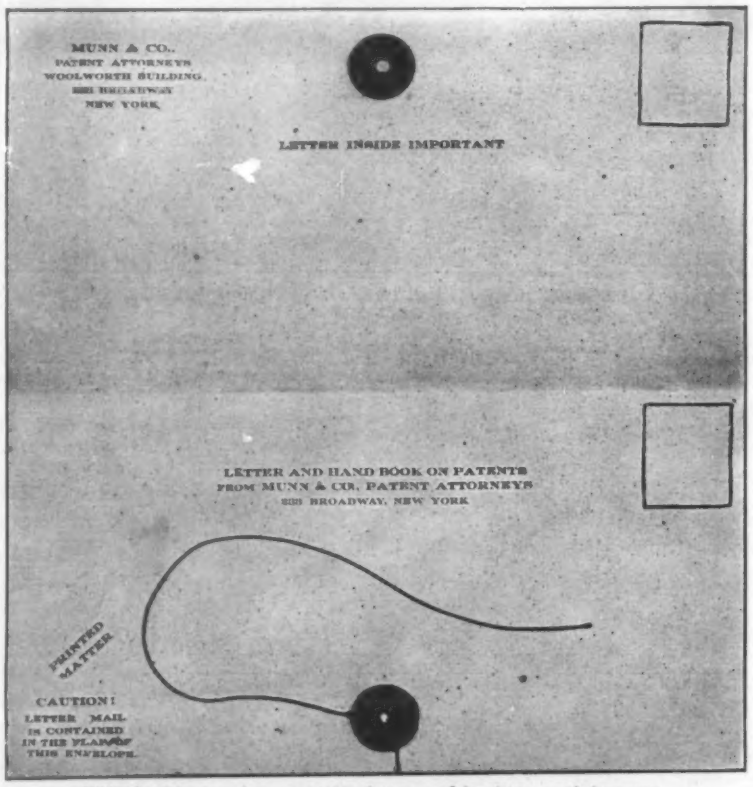
When he established his parcel post, Uncle Sam took official note of this state of affairs and enacted a regulation that a letter, properly sealed and stamped, might be attached to any parcels post package for simultaneous forwarding and delivery. But those of us who noted this concession were rather inclined to scoff at the suggestion that we attempt to hitch an envelope to our parcel in such a way as to make it stick throughout a long postal journey. When the envelope maker offers to attend to this little detail for us, however, we are forced to sit up and take notice.

An enterprising Detroit firm has just done this very thing. A typical sample of the product consists of a coarse cheese-cloth bag and a neat white envelope of correspondence size. Both open at one end, and at their closed ends they are everlastingly stitched together with good strong thread. It was through receipt of an electrotype in one of these packages, with the envelope containing a letter telling us what it was all about—and marked conspicuously "Letter Inside"—that the editorial attention was brought to the device.

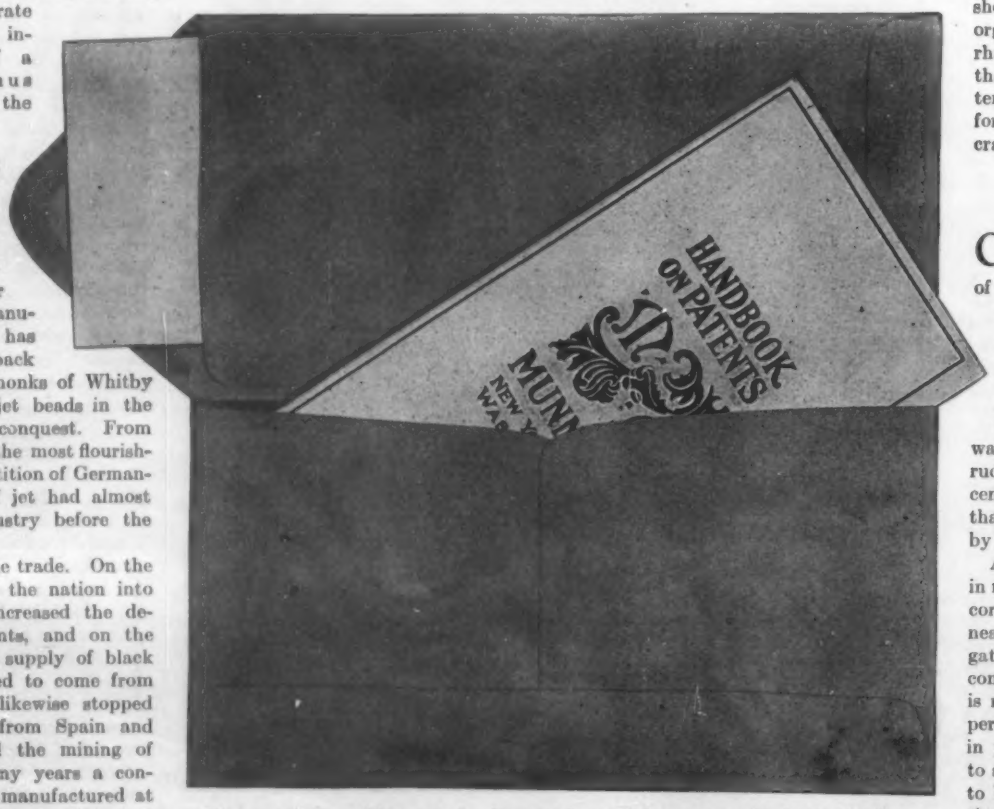
But this is only one kind. No matter what kind of an article you may wish to mail with letter attached, you can find just the right kind of a double-barreled receptacle for it, with a neat and business-like envelope for the letter firmly anchored in place. We illustrate one more application of this system which is being made right here in our own office in replying to patent inquiries; and the long-suffering victim of the "under separate cover" nuisance will instantaneously think of a thousand more, and thus sound the death knell of the aforesaid nuisance.



Device by which merchandise and letter are mailed securely fastened together



This double envelope contains letter and booklet, each bearing the appropriate postage



They reach the addressee simultaneously, and thus secure his best attention

Revival of English Jet Industry

AT Whitby on the Yorkshire coast of England, roughly halfway between the Humber and the Tyne, the manufacture of jet ornaments has been carried on as far back as records exist. The monks of Whitby Abbey used rosaries of jet beads in the days before the Norman conquest. From about 1850 to 1880 was the most flourishing period, and the competition of German-made glass imitations of jet had almost put an end to the industry before the war.

The war has revived the trade. On the one hand it has thrown the nation into mourning and greatly increased the demand for black ornaments, and on the other it has cut off the supply of black glass ornaments that used to come from the Continent. It has likewise stopped the importation of jet from Spain and correspondingly extended the mining of jet at Whitby. For many years a considerable part of the jet manufactured at Whitby was imported from Spain; but according to some connoisseurs this Spanish jet was inferior in quality to the Whitby jet and its use, in their view, contributed to the downfall of the industry by lessening the perfection of the product.

The number of men now employed at Whitby is not large, and visitors to the factories have noted that they are nearly all old men who learned their trade in their boyhood, when the industry was prosperous. This is thought to militate against the permanent revival of the industry, for there will be few young men available until the war is over to learn the crafts of carving, turning, and polishing jet which these old men are carrying on. No estimate of the quantity of jet available in the Whitby strata is procurable, but the supplies are believed to be practically inexhaustible. The future of the industry will rest on the turn of fashion.

Jet is a substance apparently allied to anthracite; indeed, ornaments have been carved from Pennsylvania anthracite, but the anthracite does not yield so fine a polished surface. It is mined in Spain in the Province of Asturias, in France in the Department of the Aude, and in Germany in Würtemberg. There is a jet museum at Whitby, with a display of specimens representing ancient as well as modern jet handicraft.

The Danger of Eating Rhubarb Leaves

THE curtailment of food supplies due to the war has led to a number of suggestions as to the use of various articles which do not usually enter into the diet of our people. Many have been the suggestions offered, for the most part excellent, but it seems that one of them has had unfortunate results. Several persons in England, according to the *Medical News*, became seriously ill as a consequence of following the advice to cook and eat rhubarb leaves, which were declared by some to be an excellent substitute for spinach, and a number of them died. One case was that of a clergyman whose death was the subject of a coroner's inquest. According to the evidence of Mr. J. Webster, a pathologic chemist, traces of oxalic acid were found in the internal organs. Oxalic acid was present in the rhubarb leaves in the form of oxalate potassium and calcium oxalate, there being approximately 10 grains of each to the pound. Dr. B. H. Spilsbury, the pathologist, who made the necropsy, said that death was due to coma consequent on poisoning from the oxalic acid contained in the leaves. In reply to the coroner, who asked whether the quantity present in the leaves was injurious, he said that in the ordinary way it might not be sufficient, but it was a borderline amount and might affect some persons more than others. Asked whether the public should be in any way alarmed about using rhubarb stalks, he said that he did not think so, as there would have been many cases of poisoning if there was any harm in the stalks. But he gave the warning that soda should not be used in cooking them. This had been suggested as an economy for sugar.

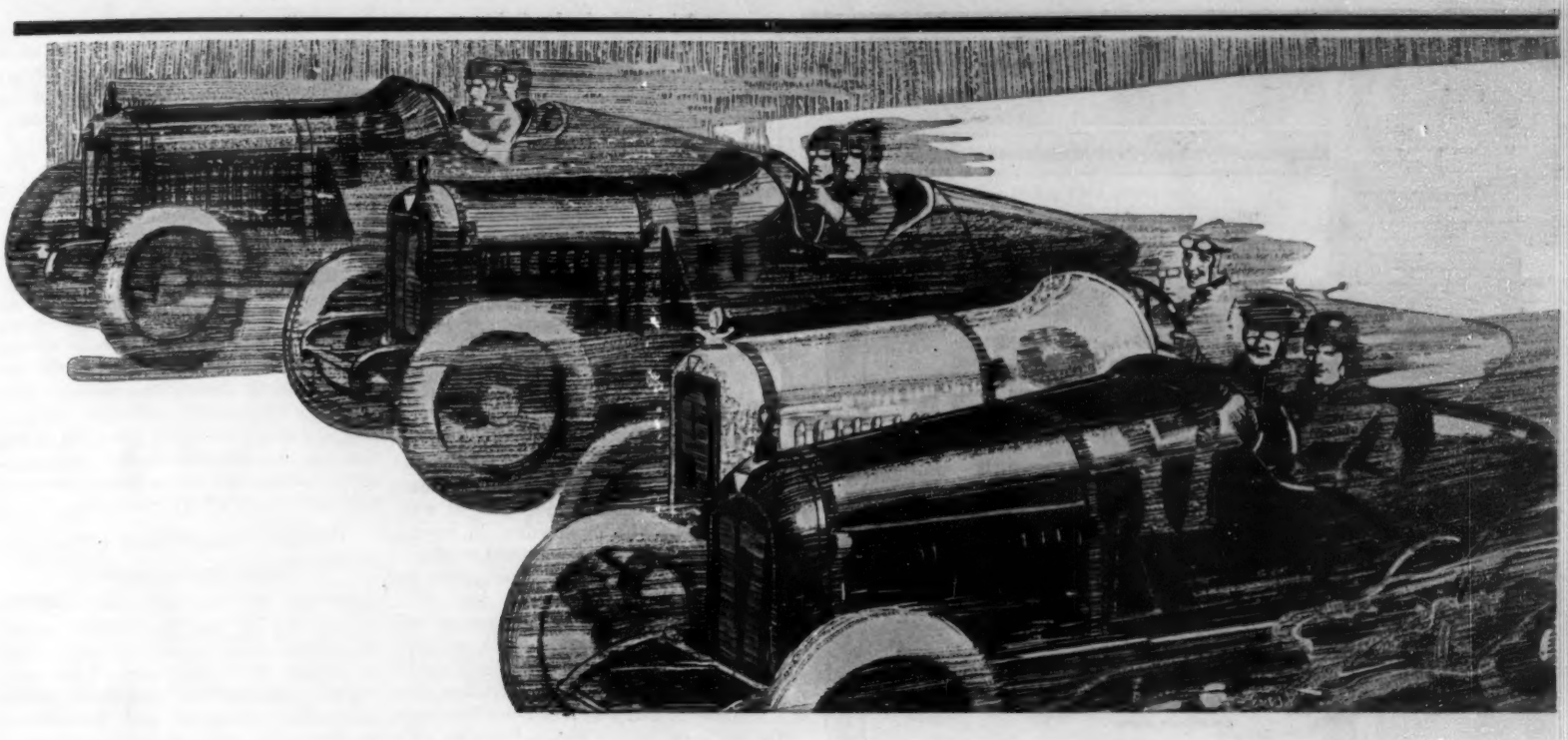
As an article in *Nature* shows, poisoning by rhubarb leaves is not new. Seventy years ago a woman in Chelsea, England, boiled rhubarb leaves as a substitute for spinach, and three persons who ate the dish became ill. In the *Transactions* of the Horticultural Society of 1848, Solly showed that nearly twice the amount of organic and inorganic matter is present in rhubarb leaves as in the stalks. For more than 100 years the stalks have been extensively used in England as a substitute for fruit, and only in rare case of idiosyncrasy have any ill-effects been observed.

Scrap Metal from Europe's Battlefields

CONSIDERABLE speculation has been going the rounds as to the amount of scrap iron and steel that is accumulating on the battlefields of Europe and how it is to be disposed of. American companies which regularly deal in such old material have for some time been looking forward to the harvest to be reaped from these battlefields after the war. These hopes have been rather rudely shocked lately by observers recently returned from the front who state that this matter is now being handled by the respective governments.

According to the systems now established in modern warfare it is stated that a salvage corps is daily going over all the ground near the battle front exposed to fire and is gathering all the debris discarded by the contending armies. None of the scrap is neglected with steel worth 2 to 3 cents per pound and copper and other metals in proportion. All the metals are taken to shops in the rear and there worked over to be cast into other various metal munitions that a modern army uses.

All the lead that is fired is practically lost as a bullet traveling at a velocity of 2,000 feet or more per second buries itself so deep into any object it hits as to be lost entirely. Other metals, however, such as tangled steel from wrecked motor cars, large pieces of shells, bits of copper, pieces of aluminum, etc., are carefully collected and later turned into usable condition.



Hudson Wins at Omaha, Tacoma and Uniontown

150-Mile Race at Tacoma
First—Third—Fourth

Eleven cars started. Three Hudson Super-Six Specials were entered and all finished. Patterson first—Roades third—Malcolm fourth.

Patterson led at 50 miles, 100 miles and finished a minute and twenty-three seconds ahead of the second car.

Roades and Malcolm each drove Hudson Super-Six Specials which were stock cars they had converted into racers. They are professional drivers who enter and drive their cars independent of factory assistance.

Two Races at Omaha
First in one—Second in other

Ralph Mulford, in a Super-Six Special, averaged 101.26 miles an hour in the 150-mile event.

There was a field of 14 starters.

Mulford made one tire change.

In the 50-mile race he finished second, 42 seconds behind a Hoskins Special.

Two tire changes in this event cost him first place.

Billy Taylor in a Hudson Super-Six Special finished fifth in both the 50- and 150-mile races.

At Uniontown
First in one—Second in three

The principal event at the Uniontown (Pa.) meet was run in three heats.

Ira Vail drove a Hudson Super-Six Special. He finished first in the 29-mile heat—second in the 10-mile and second in the 50-mile heats.

A tire change cost him the 50-mile heat by one second.

A dealer's rebuilt Super-Six demonstrator driven by a local Hudson dealer finished 15 seconds behind the winner in the non-professional event. Another rebuilt Hudson finished fourth.

Super-Six Specials Defeat Rival Racers in Every July 4th Championship Event—More Proofs of Endurance

Championship Speedway Races again reveal the mighty endurance of the Hudson Super-Six.

In the three July 4th events, Hudson endurance defeated the fastest cars known to racing.

In a field of 28 starters at Cincinnati, Memorial Day, the four Hudson Specials finished first in the free-for-all; second, seventh and ninth in the 250-mile event.

At Chicago, Ralph Mulford on June 16th established the American Speedway records for 150 miles and for 200 miles at an average of 104 miles per hour.

Made Stock Car Records Last Year

Last year Super-Six stock cars and stock chassis made new and important records for endurance, power and speed. Those were non-competitive tests. They were made against the best times of other cars.

They included the fastest stock chassis mile—the 100-mile stock car record—the one-hour stock car record and the 24-hour stock chassis record. These were officially timed by the American Automobile Association.

Then in addition to these, a seven-passenger Hudson Super-Six Phaeton broke every transcontinental automobile record. It did it both ways in the only double, twice-across-America run ever attempted against time.

All Hudson records are the result of Hudson endurance.

Cars may be built lighter and have more power, weight considered, just as most of the racers are, but none have proved an equal degree of endurance.

That is why Hudsons win.

It is why so many professional race drivers have adopted Hudsons in their speedway races.

In the three July 4th races you will note some of the Hudsons were rebuilt stock cars. They were made suitable for racing because their owners had confidence in them to win prizes.

The cars were entered independent of any factory influence.

Race drivers know that endurance wins. They know they can rely on the Hudson Super-Six to endure.

You Too Can Rely on Hudson Endurance

In converting Hudson Super-Six stock cars into racing cars these men made no change in the principle that accounts for Hudson endurance. They merely made such changes as can be made to any Hudson Super-Six. They did not have to do anything to increase the endurance quality of the cars. That quality is built into every Hudson Super-Six.

You, of course, are not interested in owning a racing car, but when racing reveals a quality so important as that of endurance, as it does with the Hudson Super-Six, then you are interested in its performance.

The speedway shows, in a few miles, weaknesses that it might require thousands of miles of ordinary service to reveal.

You want to know what you can depend upon after the car has seen thousands of miles of service. Look at these records and you will see what you may expect of the Hudson Super-Six.

The speedway test of 150 miles is more trying than thousands of miles you will drive with your car.

You want to know what the car you buy now is likely to cost in maintenance. You want to know how much time it will be in the repair shop after a half season's use. Do not these proofs persuade you to buy a Hudson Super-Six? They should. Already 37,000 have bought and they have added to these records their own experiences with the Hudson Super-Six.

There are eight body types on the Hudson Super-Six. The Phaeton 7-passenger car sells at $1650 at Detroit.

HUDSON MOTOR CAR COMPANY, DETROIT, MICHIGAN

Shutter Front Open

Furnished with Shutter Front for the HUDSON

Thousands of HUDSON car owners can tell you how their engine efficiency and gas economy is improved by the Harrison Radiator with the Shutter Front.

Remember that behind this new shutter front is the famous

HARRISON

Original Hexagon

CELLULAR RADIATOR

This particular construction (horizontal arrangement of cells) has the thinnest core, the freest water spaces and air spaces, and assures greater cooling capacity and greater strength with less weight.

Notice its performance this year on these cars:

CHANDLER, HUDSON, HUPMOBILE, MITCHELL, OLDSMOBILE, PEERLESS

also the

GRAMM and FEDERAL TRUCKS

HARRISON RADIATOR CORPORATION

Lockport, N. Y.

HARRISON HORIZONTAL HEXAGON

Shutter Front Closed

Magic, Stage Illusions and Scientific Diversions including Trick Photography

Compiled and edited by Albert A. Hopkins. With an introduction by Henry Ridgely Evans. 7x10 inches. Cloth. 556 pages. 400 illustrations, $2.50

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PARKER INK TABLETS for a soldier's "kit" in place of fluid ink.

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Photographs by Cable

(*Concluded from page 71*)

elements, other pictures into more, in accordance with the actual wealth of detail. Professor Korn uses fourteen Tesla circuits, and as each of these corresponds to a given light shading, on the one hand, and on the other to a given combination and a given letter, his scale recognizes the existence of fourteen different shadings in the make-up of a picture.

There are different possibilities for reconstructing the original picture out of the letter cablegram transmitted in the usual way. One course which has been tried and which, if perfected, bids fair to yield excellent results, consists in reproducing the picture by aid of the inventor's photo-telegraphic receiver, the cablegram being automatically reconverted into a series of perforations by well-known means. In a more or less general way, this involves the duplication, in reverse order, of the series of operations employed in passing from the original picture to the perforated tape.

Another possibility, much simpler and requiring far less expensive apparatus, consists in copying the cablegrams out on a special typewriter. The latter will comprise as many keys as there are shades in the scale, in the present instance fourteen. Its type bars carry, in the place of standard type characters, small squares or circles corresponding in size to the area of the elements into which the picture is decomposed, and are so adjusted that the intensity with which each print corresponds to the shading expressed by the letter in question. The latter, of course, appears on the face of the key, so that translation is wholly automatic. By copying off on this machine one letter after another of the cablegram, the original picture is reproduced point by point and line by line. The letter X is employed to indicate the end of the line.

Greater speed and more uniform results can be obtained by operating the typewriter with the aid of electric power. The speed of operation is further increased by subdividing the picture into several sections, to be copied by different typists. As neighboring elements seldom vary abruptly, the mechanical nature of the work may be greatly increased by adopting various code letters for combinations, repetitions, etc. It is pointed out that this typewriter scheme, new in itself, is equally applicable to the ordinary photo-telegraphic technique. Moreover, the entire process as here outlined seems available for radio-telegraphic transmission of photographs.

The Submarine Problem—X.

(*Concluded from page 74*)

two 5.9-inch, long-range rifles mounted permanently on deck. They are heavily coated with grease and no attempt is made to slide them down into a hatch-covered recess before submerging.

Now, the 5.9-inch gun has an effective range of something over 9,000 yards, and it fires a 100-pound shell—shrapnel or high explosive, as the case may be. Moreover these latest boats carry three inches of armor on the conning tower and we are informed—though we do not vouch for the truth of this—that in some cases the armed conning tower has been sufficiently enlarged to constitute a barbette within which these powerful guns are mounted.

Be this as it may, we ought to take time by the forelock and mount on our new destroyers, converted yachts, and big patrol boats, and of course upon our merchantmen, the largest-caliber gun that can be provided and accommodated. Our long 51-caliber, 5-inch gun is a splendid weapon for this work. It has a very high velocity and flat trajectory, a rapid rate of fire, great accuracy, and is a fair match for the German 5.9 gun. Prudence and foresight suggest that our Government should place orders for several thousand of these guns, so that we may be prepared to meet the increase in power of submarine armament, which undoubtedly is going to take place.

In the running fight between a merchant ship and a submarine the balance of advantage lies with the ship, and this for the following reasons: the merchant ship guns fire from a much steadier platform; they have a high command; the gunners are free from the interference of breaking seas and spray; and whereas a single well-placed shot will disable or sink the submarine, a merchant ship might receive 20 such before fatal injury was done to her engines or boilers.

All the above is written on the understanding that we are going to let the submarine get out on to the high seas and fight them there; but we draw attention to the fact that if the German U-boat fleet were shut in within the North Sea the chances of finding and sinking them would be enormously increased. Indeed, it is our firm belief that once the North Sea net was established, the conclusion of the German U-boat campaign would be a matter of only a few weeks' time.

Coal at Thirty Cents a Ton

(*Concluded from page 79*)

negro did, to the satisfaction of the lawyer, for it was immediately established that there was enough coal in sight to furnish the whole town, if need be. Figuring closely, the proprietor of this indoor mine estimates that there are at least sixty to seventy thousand tons of coal under his property, which is 100 by 300 feet. The next operation was to determine the cost of mining it. Taking into consideration every item entering into the mining operations, including the initial layout for car and digging tools and the negro's pay, he says he can mine all the coal he wants for 30 cents a ton.

One significent feature about the mine is that the vein dips up hill about eight per cent, which allows the water to run out of the face of the opening and permits the miner to give the coal car, when filled, a gentle push to send it to the mouth of the hot-water heater. In one of the accompanying photographs will be seen the basement of the house, the coal car filled with coal, and the hot-water heater dial measuring a pressure of about seventy pounds.

Another interesting point is that the owner of this personally conducted mine cannot sell his coal. The coal barons of Norton own the mining rights of the vicinity; consequently if he wants to dispose of his coal he will have to give it away.

Specialization as an Aid to War-Time Industry in England

A MOVEMENT has been initiated by the Association of British Machine Toolmakers for a greater degree of specialization among machine-tool builders. According to the *Yorkshire Post*, it is reported that ten machine-tool firms have arranged among themselves that each shall devote itself to the production of a single type of machine. One will confine itself to drilling machines, another to boring mills, and so on. Besides reducing to manageable proportions the numbers of patterns and drawings to be kept, such a policy permits of the production of machine tools being placed upon a manufacturing instead of a "jobbing order" basis and enables the maker to concentrate all his effort and talent upon the improvement of his one line of product.

The arrangement also lends itself to the appointment of group publicity agents and travelers, both at home and abroad. The carrying of foreign trade through the medium of independent general agents has on the whole proved far from satisfactory, but hitherto the majority of machine-tool makers have had to rest content with that means for the reason that their turnover was not large enough to bear the expense of sending a special agent to the leading foreign centers, much less of keeping one there permanently, while it has not been easy for a group of firms that were all competitors in certain products to combine for the establishment of joint foreign agencies. Under the system of specialization by group impact, these difficulties disappear, and it is understood that the better organization of foreign publicity and sale is one of the chief objects of the new project.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of SCIENTIFIC AMERICAN.

Pertaining to Apparel

GARMENT.—LAURA K. LITCHFIELD, 618 W. 142d St., New York, N. Y. The invention provides a one-piece garment arranged to produce the effect of a skirt and bloomers; provides a garment adapted to permit ease and freedom of the legs; provides a one-piece skirt garment closed at the bottom; provides a bloomer-like garment having a skirt portion, and provides a bathing garment, the bottom portion of the skirt whereof cannot be lifted to remain on or above the wearer's hips.

COMBINED UNDERGARMENT AND JOCK-STRAP.—H. ZETOSCH, care of Mrs. Victor, 209 W. 140th St., New York, N. Y. By means of this invention the user is enabled to readily don or remove the garment. The invention provides convenient means for sanitary purposes, and permits removal of the elastic jock strap portions to allow laundrying of the garment without injury to the elastic portions.

SHOE POLISHING MACHINE.—W. C. SCHADE, 161 Lincoln St., Jersey City, N. J. This invention relates to shoe-polishing machines of the automatic type, and comprises in a shoe-polishing machine the combination of a foot rest, a brush frame mounted to oscillate on a horizontal plane, and brushes carried by the frame and mounted to oscillate on a vertical axis.

GARMENT PROTECTOR.—C. A. CONOVER, 53 Water St., Newburgh, N. Y. This improvement pertains to the protection of clothing when not in use, and provides a container of the bag type which may be adapted for use with evening or holiday clothing, or which may be adapted for the protection of clothing against moths during the summer months.

NECKTIE ADJUSTER.—W. S. MARR and J. E. NELSON. Address W. P. Hall, Attorney, Holdredge, Neb. This adjuster is in the nature of a strip of flexible metal having means for securing it within a collar between the folds thereof, the metallic band being fitted at its ends with loops around which the necktie is adapted to be caught, whereby the tie may be readily slipped back and forth to acquire correct adjustment, and whereby much shorter neckties than commonly in use, may be used.

Of Interest to Farmers

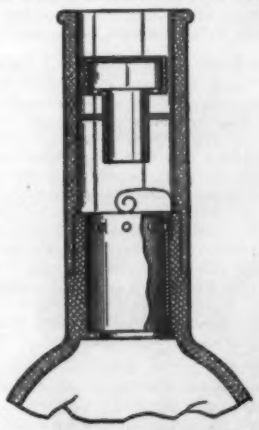
MEDICATED EGG.—J. G. BURNS, 315 E. Madison St., Pulaski, Tenn. The general objects of the present invention are the provision of a nest egg made of a new composition and by a new method whereby a sufficient porosity is obtained to permit the liquid disinfectant to pass through the walls to the surface of the egg.

SILO-ROOF.—J. PATTERSON, Versailles, Ill. The invention relates more particularly to the construction of the upper portion of silos, including the roof, arranged in sections to permit of opening and closing the same and knock-down structure to constitute when erected a vertical continuation of the silo chamber, the object is to promote strength, durability, and effectiveness.

Of General Interest

SENSITIVE PERCUSSION FUSE.—E. R. STUART, U. S. Army, West Point, N. Y. In order to accomplish the object of this invention, use is made of a firing device and a fulminate carrier normally out of striking position relative to the firing device and capable of moving into striking position relative to the striking device by centrifugal force on the revolving of the projectile.

NON-REFILLABLE BOTTLE.—F. Q. CUESTA, care of Mr. Casquero, 76-78 Cuba St., Habana, Cuba. This invention provides an arrangement which will be inexpensive in the manufacture and which will permit the free flowing of fluid from the bottle while resisting refilling



NON-REFILLABLE BOTTLE

of the bottle. It provides a closure member which is connected with and forms part of the neck of a bottle and arranged so that there will be a movable valve and various guarding means for preventing the actuation of said valve except by the fluid in the bottle.

VISCOUS FLUID APPLIER.—L. L. STEVENSON, 528 Commercial St., Emporia, Kan. This applier is arranged to enable the user to accurately control the outflow of the mucilage, liquid glue, fluid cement or other similar viscous fluid as needed or desired, and arranged to quickly respond to the pressure exerted by the user and needed for expelling the fluid to cause the flow to cease instantly the pressure is released and to prevent leakage.

DISPLAY RACK.—B. STERN, 47 Claremont Ave., New York, N. Y. The object here is to provide a structure on which a large number of similar articles of different quality or pattern can be rapidly exhibited and the arrangement of which articles on the rack is such as to give substantially the appearance of the article in use.

HOLDER FOR LOOSE LEAF BINDERS.—F. H. CRUMP, 225 E. 4th St., Los Angeles, Cal. This invention relates generally to supports for loose leaf binders while the leaves thereof are being marked, typewritten or otherwise engrossed, and among other objects aims to provide means for temporarily supporting a loose leaf binder with its detachable sheets, so that the binding members may be removed and the sheets freed.

Hardware and Tools

GAGE.—S. FRIEDMAN, 238 Keap St., Brooklyn, N. Y. In the present patent the object of the invention is the provision of a new and improved gage for internal and external gaging purposes and arranged to permit convenient gaging of rotating work without danger of the gage sticking to the work.

COMBINED Y-VALVE AND HOSE CONNECTION.—F. MILLIKEN, care of McNab & Harlin Mfg. Co., 55 John St., New York, N. Y. This invention relates particularly to a hose connection and Y-valve for distributing by a fluid, as for instance, water, gas, compressed air and the like, granular or abrading matter of any kind, as sand, cracked stone, gravel, mixed concrete and the like, and provides a construction which will wear for a comparatively long time while permitting a continuous discharge of material when the device is in use.

RAZOR STROPPER.—B. TROSKY, 477 13th St., Brooklyn, N. Y. This invention relates to safety blade stroppers of that type comprising rotary stropping elements coacting to sharpen the edge of a razor blade placed in coöperative relation with the said elements. It provides a blade holder whereby it can be readily adapted for double or single edge blades.

GLASS-CUTTER.—S. G. MONCE, Unionville, Conn. The object of the invention is to provide a glass cutter very simple in construction, the body of the cutter having clamped members operable by a movement of the handle relatively therto to secure a detachable mounting on which the glass cutting wheel is rotatably mounted.

ROCK-DRILL.—M. SMITH, care of New Bedford Hotel, Mich. Ave and 30th St., Chicago, Ill. The invention relates to rock drills of the type in which water is fed through the drill iron to the cutting end, one of the main objects is to provide a constant supply of water to the reciprocating tapped and thence to the drill iron in a non-leakable manner, and with minimum of friction between the operative parts.

Heating and Lighting

DRIER.—W. J. KUNTZ, Address Ruggles, Coles, Engineering Co., Box 505, York, Pa. This improvement refers more particularly to feed heads of driers of that type including rotating drying shells, a stationary feed head, and forced draft means through the shells and the feed head, and provides a construction adjacent the feed head whereby to obviate certain of the disadvantages in constructions of this character as now used.

LIGHT ATTACHMENT FOR SEWING-MACHINES.—H. B. ALLYN, Address Angelo T. Bertolini, 1705 Taylor Ave., Bronx, N. Y. The general objects of the invention are to improve the construction of light attachments for sewing machines so as to be reliable and efficient in use, comparatively simple, and so designed as to provide for the universal adjustment of the lamp while the attachment is applied to the arm of the sewing machine. A lamp attachment whereby the light can be thrown in any desired direction.

ACETYLENE-GAS GENERATOR.—G. T. CUNNINGHAM, Shreveport, La. Objects of this invention are to provide an acetylene generator wherein the gas is automatically generated but which is equipped with an emergency valve operating device which will be brought into play, when an abnormal pressure is generated, so as to prevent the feed of carbid to the water. A further object is to provide in which the gas pressure which operated the automatic carbid feed is taken by a by-pass to a diaphragm disposed on the opposite side of carbid hopper from the feed valve.

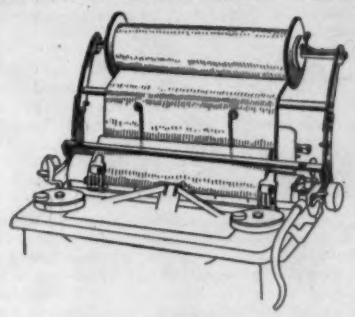
Household Utilities

COMFORT-CHAIR.—A. G. ZUNIGA, Lima, Peru. An object of the invention is to provide a chair in which there is a swinging back and foot rest, with means for locking the swinging back at any desired point of the swing arc of the back. A further object is to provide a swinging back and foot rest which are foldable on the seat. A still further object is to provide a collapsible support from which the chair may be suspended, to swing with means carried by the support to lock the swinging movement of the chair in the support.

Machines and Mechanical Devices

PRINTING MACHINE.—E. DAKE, East 3d St., Medford, Wis. This machine prints photographic prints from negatives, wherein a closed cabinet is provided with means to assist in positioning the prints, and wherein a supporting frame for the lighting mechanism is provided supporting a series of lighting devices, and a second frame arranged wherein a ruby-lighting device is arranged, a platen provided and a switch controlled by the movement of the platen for alternately connecting first named lighting devices and last named device with an electric circuit, and wherein means provide for cutting either of the first named devices into or out of the circuit, independently of the others.

PAPER FEEDING DEVICE FOR TYPEWRITING MACHINES.—J. P. BURKS and C. M. YOUNG, Helena, Ark. The invention relates to improvements in type-writing machines and more particularly to the paper feed mechan-



PAPER FEEDING DEVICE FOR TYPEWRITING MACHINES

ism whereby a continuous web of paper may be fed to the platen, and has for an object to provide a simple, cheap and efficient attachment for typewriters for holding a roll or web of paper, feeding it to the platen and severing the web into sheets of the desired size.

FRICTION GEARING.—W. E. BUFFAT, Greeneville, Tenn. The invention relates more particularly to improvements in the adjustable member connecting the driving and driven members in a friction gearing, and adjustable therebetween to vary the speed of movement transmitted from one to the other, and provides a friction connection which will do away with all the difficulties, and obviate many of the disadvantages of the disk usually used for this purpose.

EYEGLASS CASE.—R. A. GOEKEL, 601 W. 137th St., New York, N. Y. This invention permits the lenses of eye-glasses being wiped or cleansed while in their containing case; insures the delivery of eye-glasses from their containing case in condition for personal wear; and provides a mechanical wiper for eye-glasses, the movements of the parts whereof simulate the movements imparted by the human hand when cleansing the lenses of eye-glasses.

SEMI-AUTOMATICALLY- OPERATED GUN-BREECH MECHANISM.—E. RIMALIHO, Address Picard, 97 Rue St. Lazare, Paris, France. The invention relates to semi-automatically operated gun breech mechanisms, in which a portion of the momentum of the recoil is stored by springs for introducing the operation of the breech block and the ejection, a form of mechanism for sliding breech blocks applied to a gun using metallic cartridges.

OIL-CUPS.—R. O. PAINE, Ansley, Neb. The invention relates particularly to oil-cups for moving machines, sickels and the like, it has for an object the provision of a construction whereby the cap is locked in any adjusted position. A further object is to provide a cup in combination with the wrist pin of a crank member whereby oil may be forced through part of the wrist pin longitudinally and then laterally to the surface.

DIFFERENTIAL MECHANISM.—F. CARLISLE, Monticello, N. Y. This invention improves the construction and operation of differential mechanisms so as to be reliable and efficient in use, and so designed that there will be a positive application of power to the driving wheels during forward or rearward propulsion, or while turning. It is especially adapted although not limited to automobiles.

Railways and Their Accessories

CAR FENDER.—J. P. GERAGHTY, care of Mooney, 493 Grove St., Jersey City, N. J. The invention relates to car fenders arranged under the car platform immediately in front of the wheels and connected with a gate at the forward end of the platform. The present invention is an improvement on car fenders such as shown and described in Letters Patent of the United States, No. 1,090,295 granted to J. P. Geraghty and G. W. Naylor, on March 17th, 1914.

SIDE DUMPING HAND CAR.—J. G. MEREDITH, Lynchburg, Va. This invention provides a car in connection with which material may be loaded on, and dumped from, at points laterally beyond the track bed; and provides a

SIDE DUMPING HAND CAR

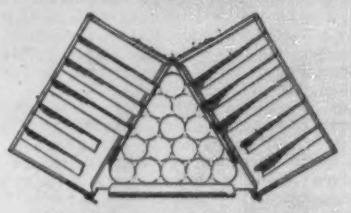
car by means of which the loading and dumping operations may be greatly facilitated, which will be a time saver in use, and which will obviate the necessity for the usual dumping boxes located upon flat cars, at present for the same purpose.

LUBRICATOR.—O. SWANSON, 4783 Bryant St., Denver, Colo. This invention provides a simple and efficient lubricator which can be easily adjusted relative to the flanges of the wheel in railway rolling stock and which is characterized by a nozzle having a vibrator therein whereby lubricant is supplied only during the motion of the wheel.

TRAIN SIGNALING AND STOPPING DEVICE.—K. REGER, Route 2, Box 10, Buckhannon, W. Va. By means of this device any one of a plurality of signals disposed along the track, may be thrown or operated from a central point or station; and by means of which the operation of the signaling device at any station may be accomplished by electrical means involving the use of one main wire or conductor; in other words to provide a selective system.

Pertaining to Recreation

POOL BALL RACK AND TRIANGLE.—J. E. NITKEY, Harrison, Idaho. This improvement provides a rack structure combined with a triangle structure whereby by a proper movement of the combined device the balls may move from the rack structure into the triangle structure and



POOL BALL RACK AND TRIANGLE

be properly and quickly assembled on the table. The rack is arranged with a plurality of shelves or slats for receiving the balls of different players and automatically causing the same to assume the proper position for discharging when the balls are to be rearranged or again placed upon the table.

Pertaining to Vehicles

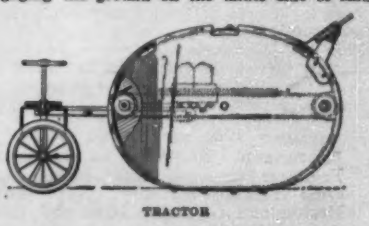
ARMORED AUTOMOBILE.—E. M. BLACKSHER, P. O. Box 378, Hot Springs, Ark. In this device a protective casing is mounted on the automobile, in such manner that the vital parts of the automobile and the occupants will be shielded and protected, and wherein the casing

ARMORED AUTOMOBILE

carries a revolvable turret, the casing being yieldingly connected to the frame of the automobile to yield in every direction, and wherein auxiliary supporting means is provided in connection with the casing for supporting the weight of the same and the arms and munitions carried thereby, to relieve the frame of such a weight.

ATTACHMENT FOR MOTOR VEHICLES.—J. D. HENDERSON, 324 N. Tenth St., Monmouth, Ill. This invention is an improvement in attachments for motor vehicles, and has for its object to provide an attachment capable of attachment to a car for insuring the driver against injury and kicking back of the motor during the cranking of the car.

TRACTOR.—J. MOSCA, Rouse, Colo. The tractor is for use in soft roads, as for instance in snow or mud, wherein the tractor is driven by an endless belt traveling about a fixed element and engaging the ground on the under side of said



TRACTOR

element, and having means for preventing slipping of the belt, and wherein front wheels are provided for smoothing and compacting the roadway for the propelling means, and wherein cleaning means is provided for the belt and front wheels.

RESILIENT WHEEL.—LE ROY B. CARRIS, R. R. No. 2, Sioux Rapids, Iowa. This improvement refers to vehicle wheels and more particularly to the tire which is made yieldable to compensate for shock, thereby adding to the comfort of the occupant of the vehicle and minimizing the wear and tear on the running gear and the motor and adjunctive parts of automobiles.

VEHICLE SIGNAL.—A. VAN A. FELTEN, 38 Morris St., Danbury, Conn. The inventor provides a signal which enables the driver of a vehicle to signal to vehicles in the rear that his vehicle is going to change its course. He provides a signal combining the rear sight mirror of the driver with a semaphore-like signal housed in the mirror casing and operable by the driver to indicate that he is going to stop or change his course, and thereby prevent collision with vehicles approaching from the rear.

AIR VALVE.—H. B. ASHELMAN and J. S. JOHNSON. Address the former, Fargo, N. D. The invention provides an air valve including means for preventing an excess of pressure in a pneumatic tire with which the valve is associated. It provides a valve on which the means preventing an excessive pressure can be adjusted so as to cause the operation of said releasing means at various predetermined pressures.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

MEDIEVAL AND MODERN TIMES. An Introduction to the History of Western Europe from the Dissolution of the Roman Empire to the Opening of the Great War of 1914. By James Harvey Robinson, Ph.D., Professor of History, Columbia University. New York, Boston and Chicago: Ginn and Company. 8vo.; 789 pp.; illustrated. Price, $1.60 net.

This excellent text for high and preparatory schools is based upon the author's "Introduction to the History of Western Europe." The space devoted to medieval times and the Church has been greatly reduced, and more recent events and developments have received a correspondingly fuller treatment. A nice discrimination has been employed in the selection of the numerous illustrations; each has its own distinct educational value and each its own explanatory legend supplying origins and meanings. Many are full-page colored reproductions capable of conveying artistic values to the student-mind. The same discrimination is evident in the twenty-seven maps interspersed throughout the volume. Under such interesting captions as "How Louis XVI tried to play the Benevolent Despot," and "How Bonaparte made himself Master of France," historical facts are presented with the vitality of live issues, and the acquisition of knowledge is shown to be not incompatible with lively interest.

IRRIGATION WORKS CONSTRUCTED BY THE UNITED STATES GOVERNMENT. By Arthur Powell Davis, Chief Engineer, U. S. Reclamation Service. New York: John Wiley & Sons, Inc., 1917. 8vo.; 430 pp.; illustrated. Price, $4.50 net.

Under the Reclamation Act of 1902 a hundred million dollars have been expended in construction work; twenty-five projects are in operation, prepared to deliver water over a million and a half acres; two-thirds of this acreage was actually supplied with water in 1916. Considerations of economy exclude from the annual reports all engineering descriptions; it is this aspect of the marvelious accomplishment that is so ably set forth by Mr. Davis. His well-illustrated volume presents twenty-one of the great irrigation projects from the engineering point of view, minutely describing the salient features of each with tables of area and capacity, analytic diagrams, and data of costs and expense of operation and maintenance. The work is one of strong appeal to those interested in the general subject of irrigation, or in the accessory details of reservoirs, dams, power development and canal systems.

THE SEVEN WONDERS OF THE ANCIENT WORLD. By Edgar J. Banks, Ph.D. New York: G. P. Putnam's Sons. 8vo.; 202 pp.; illustrated. Price, $1.50.

Modern research has proved these ancient wonders to have borne a very different aspect from that of popular conception. This work carries a folding map showing the sites of the wonders, and a plan of the ruins of Babylon. The illustrations reconstruct for us as accurately as is now possible the pyramid of Khufu, the walls of Babylon, the statue of the Olympian Zeus, the Temple of Diana, the tomb of King Mausolus, the Colossus of Rhodes, and the Pharos of Alexandria. Old records have been checked against new discoveries to furnish the text; the result is seven stories of enthralling interest.

EQUIPMENT FOR THE FARM AND THE FARMSTEAD. By Harry C. Ramsower, Professor of Agricultural Engineering, Ohio State University. New York, Boston and Chicago: Ginn and Company, 1917. 8vo.; 535 pp.; illustrated. Price, $2.25 net.

Students of agriculture and farmers now have many books on profitable crop and live-stock production, but instruction has not kept pace with the rapid development of equipment. Yet a fifth of the total value of farms in the corn belt is represented by buildings and machinery, and water supply, sewage disposal and lighting systems are subjects no longer to be ignored. Mechanical principles involved, the transmission of power, the various building constructions and materials, the lay-out of the farm, and the operation of pumps and windmills are readably set forth; tillage tools, seeding machinery, manure spreaders, haying machines, grain binders and corn harvesters are explained in detail, and there are chapters on gasoline and oil engines and the rope and its uses. "Easier labor and lighter burdens" might well be the text of the discourse which is cast into pedagogic form for the student, yet keeps practical needs strictly in view.

SUCCESS IN THE SUBURBS. How to Locate, Buy, and Build; Garden and Grow Fruit; Keep Fowls and Animals. By John R. McMahan. With a foreword by O. S. Morgan, Department of Agriculture, Columbia University. New York: G. P. Putnam's Sons, 1917. 8vo.; 373 pp.; 34 illustrations. Price, $2 net.

Of the making of books there is no end—and never will be so long as man thinks himself qualified to teach of anything that he has once seen or touched upon. But "Success in the Suburbs" and the man who wrote it are not in the above category; Mr. McMahan, "a pioneer by force of circumstances," fully convinces us that "the commuting zone. . . deserves the searchlight and the microscope of science." He gives us here his own field notes, chatty, humorous, yet always penetrating and practical. We learn how to scout for a suburban home, how to finance the undertaking and build or remodel the house, all about the legal fixings and fences, water, sewage and heating and lighting. The author does not merely see us well established, but teaches us the manifold uses of the modern tools that make the man of today equal to several of his grandfathers; he takes us into the garden and shows us how to make the earth feed us; and he talks of animals—pets, pests, and useful ones. If you would be a successful and happy suburbanite, this thrift-book will prove just what you have been looking for.

RIDER'S NEW YORK CITY. A Guide-Book for Travelers. Compiled and edited by Fremont Rider, with the assistance of Frederic Taber Cooper, Mary Alden Hopkins and others. New York: Henry Holt and Company, 1916. 12mo.; 548 pp.; with 16 maps and 18 plans. Price, $3.10 net.

The need of a comprehensive guide book to our great western metropolis has long been felt: the few pages offered by Baedeker do scant justice to the wealth of interesting places and objects which New York holds for the sightseer. In many ways Mr. Rider's work admirably fills this need; it is at least a well-systematized start, with mention of most of the features of strong appeal, and it will greatly further both the physical comfort and the esthetic satisfaction of the traveler. It is to be regretted, however, that so many errors of statement and of typography have crept into the pages; as instances, the Union League Club is placed on the N.W. corner of Fifth Avenue and Thirty-ninth Street, instead of the N.E. corner; the curator of the Jumel Mansion is W. H. Shelton, not W. H. Sheldon; there are lapses in the reference to George Grey Barnard's "Cloisters," and in the paragraph on the old Dyckman house, the latter making no mention of the fact that this has for some time been used as a museum. This is all the more annoying as a hut has been built by Mr. Bolten and his associates in the Gardens. This hut is a replica, built with original materials, obtained from the Hessian and other Revolutionary huts, which have been excavated during the last two or three years, within a few hundred feet of the Dyckman house. Such errors and oversights will doubtless be corrected in future editions; in the meantime, and in spite of them, the traveler will find the guide of unquestionable value, and its usefulness is further enhanced by the inclusion of Newark, Yonkers, and Jersey City.

LETTERING FOR DRAFTSMEN, ENGINEERS AND STUDENTS. A Practical System of Freehand Lettering for Working Drawings. By Chas. W. Reinhardt. New York: D. Van Nostrand Company, 1917. 4to.; 55 pp.; 15 plates. Price, $1 net.

This standard work, now in its fourteenth edition, still holds its own as a practical exponent of freehand lettering for working drawings. New plates analyze the Greek alphabet and present various attractive methods of laying out titles. For ornate alphabets the draftsman must look elsewhere; but for a system of lettering that is rapid, yet artistic, and that comes out sharply under photographic reduction, he can find no better guide than is here offered.

THE VAPORIZING OF PARAFFIN FOR HIGH-SPEED MOTORS. By Edward Butler, M. Inst. Mech. E. Philadelphia: J. B. Lippincott Company, 1917. 8vo.; 128 pp.; illustrated.

Mr. Butler writes from London, but his previous works on oil fuel and the internal combustion engine are not unknown in America. This monograph on the use of paraffin or kerosene as a fuel for high-speed motors of the electric ignition type is issued at an opportune time. It presents the various types pf petrol carburetors, and reviews the present situation in regard to the vaporization of paraffin both in oil engines and the high-speed marine engine, with a special chapter on its adaption to road car and tractor motors. The necessary carburetor vaporizes are clearly illustrated in their several different forms, and the book will prove a source of helpful information to those interested in the subject.

STONE ORNAMENTS USED BY INDIANS IN THE UNITED STATES AND CANADA. By Warren K. Moorehead. Andover, Mass. The Andover Press, 1917. 8vo.; 448 pp.; illustrated.

Among the relics of American Indian life are found many ornamental shapes in stone, to certain of which the archaeologist has been driven to give the name "problematical forms." These occur in profusion in various localities, and have given rise to much interesting speculation. Hitherto there has been no volume dealing at length with these ornamental forms; Mr. Moorehead now gives us a monograph that is entirely worthy of its subject. Amulets, banner-stones and bird-stones, pendants, gorgets, plummets and miscellaneous forms are extensively treated in text and illustration; artistic plates in color give almost as clear an idea of appearance as if the objects themselves were before the reader, and maps show the distribution of these shapes in the United States and Canada. Other authorities examine the criteria of age and discuss other questions that present themselves, and the conclusions of the author form valuable closing chapters. There is also a very full bibliography, and a detailed index provides easy reference.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14233) S. K. K. asks: We would like to inquire if it is possible to give a conducting body a charge by passing it through a field of force of a permanent, or other magnet, a charge that it will retain until it contacts with another body. It is assumed that the body to be charged is insulated, in other words, is free from contact with all adjoining objects and the earth. To make the proposition plain, can an insulated brass ball by passing it rapidly through the field of force of a magnet be given such a charge that the charge will be carried by the ball until discharged by coming in contact with another object. A. If a conductor is passed through a field of force, the current induced in it while entering the field, with the increasing density of the field, will be in one direction, and while leaving the field the current will be in the opposite direction. When it leaves the field it will be in the same state as when it entered it. It will not at any time have a charge induced in it, which it can retain and carry to another body, as it will when it is charged by a static machine.

(14234) E. L. H. asks: 1. Please publish in your issue of next month the theory of how Frictional Electricity is collected on a revolving belt more pronounced in winter than in summer. 2. And am I right in stating that the forces that govern the Marines' compass, which extend from equator to north and from equator to south over the earth's surface come in contact with properties of Matter which are capable of ascending when subjected to heat, and these properties in their ascent have collected on them magnetic forces, which, when the equilibrium is established, are laden with powerful electric energy and will discharge this energy back to earth when coming in contact with a high object extending into their zone, thereby causing electric storms in hot weather? Also do not the magnetic forces across the globe travel on a higher plane in warm weather than in cool? A. 1. The reason why a belt is more easily electrified in cold than in hot weather is that the air is drier on the average in cold weather than in hot weather. The electricity is generated by friction at all times, but when the air is moist the electricity is discharged from the belt or other article on which friction is exerted and we do not perceive that it has been electrified. If there were no resistance we should never know there was any electricity in the world. 2. The production of an electrified cloud is perhaps a simpler matter than your statement of it. The air reaches saturation somewhere on a hot day in summer, and a cloud is formed. The origin of the electricity in the air is not well understood but the combining of the small particles of water into large drops is believed to have much to do with the increase of the intensity of the electrcity in the cloud. When the intensity is great enough the flash comes by the breaking down of the air between the cloud and the earth. This does not seem to be in any way connected with the magnetism of the earth, which is permanent. The earth is a great magnet. How it became a magnet we do not know.

(14235) H. A. S. asks: Will you kindly settle a dispute between several of your subscribers. The argument as as follows: A wagon, or automobile or any four-wheeled vehicle, turning a curve at a high rate of speed, which wheels leave the ground first, the outside or inside. By favoring me with your expert opinion, I thank you in advance. A. A vehicle which is overturned by rounding a corner at too high a speed is overturned by the centrifugal force, which acts toward the outside of the curve, and exerts a pressure outward on the vehicle through its center of gravity. As this point is at some distance above the ground it is evident that the pressure is exerted to raise the vehicle on the line of the outer wheels, so that these will remain on the ground and the inside wheels will leave the ground first. A vehicle which overturns by centrifugal force does not turn over toward the inside of its curve. If it did, the outside wheels would leave the ground first.

(14236) H. S. H. asks: 1. How large are the German torpedoes supposed to be? 2. Could not a submarine discharge a torpedo even if it were lying on the bottom of the ocean? 3. Does the torpedo travel on the surface or submerged and if submerged how fast and at what depth? 4. While traveling is it parallel with the surface or at an angle? 5. When the torpedo is spent does not a trap or something open and cause it to sink so that it is harmless? 6. If it traveled on the surface would it not be an easy task to destroy it by gun fire? A prominent citizen and inventor made the assertion a few days ago that a submarine had to expose itself in order to discharge a torpedo, which statement has led to a considerable discussion, and I am herewith asking you a few questions, an answer to which would be greatly appreciated. If you will kindly answer these questions in monosyllabies on this paper I will be greatly obliged, but if you do not answer questions in this way I will look for it in the future issues of your esteemed paper. A. 1. We have no authoritative information at hand on German armament in use at the present time. We believe that the modern torpedo used by Germany is about 18 inches in diameter and about 18 feet long. 2. A submarine could discharge a torpedo while lying on the bottom of the ocean, but it is just as necessary to aim a torpedo as it is to aim a gun and this may be accomplished only with the periscope exposed. 3. A torpedo travels submerged at from 10 to 20 feet. 4. The depth of submergence of a torpedo is established by hydrostatic control of the horizontal rudders. Consequently its course in the vertical plane is undulating. 5. A torpedo armed with the war-head has a negative buoyancy and therefore sinks when the air supply is exhausted. 6. If torpedoes were to travel on the surface they would not necessarily be an easy mark for gun-fire as the speed of the modern ones is sometimes as high as sixty miles per hour, but they could be easily deflected.

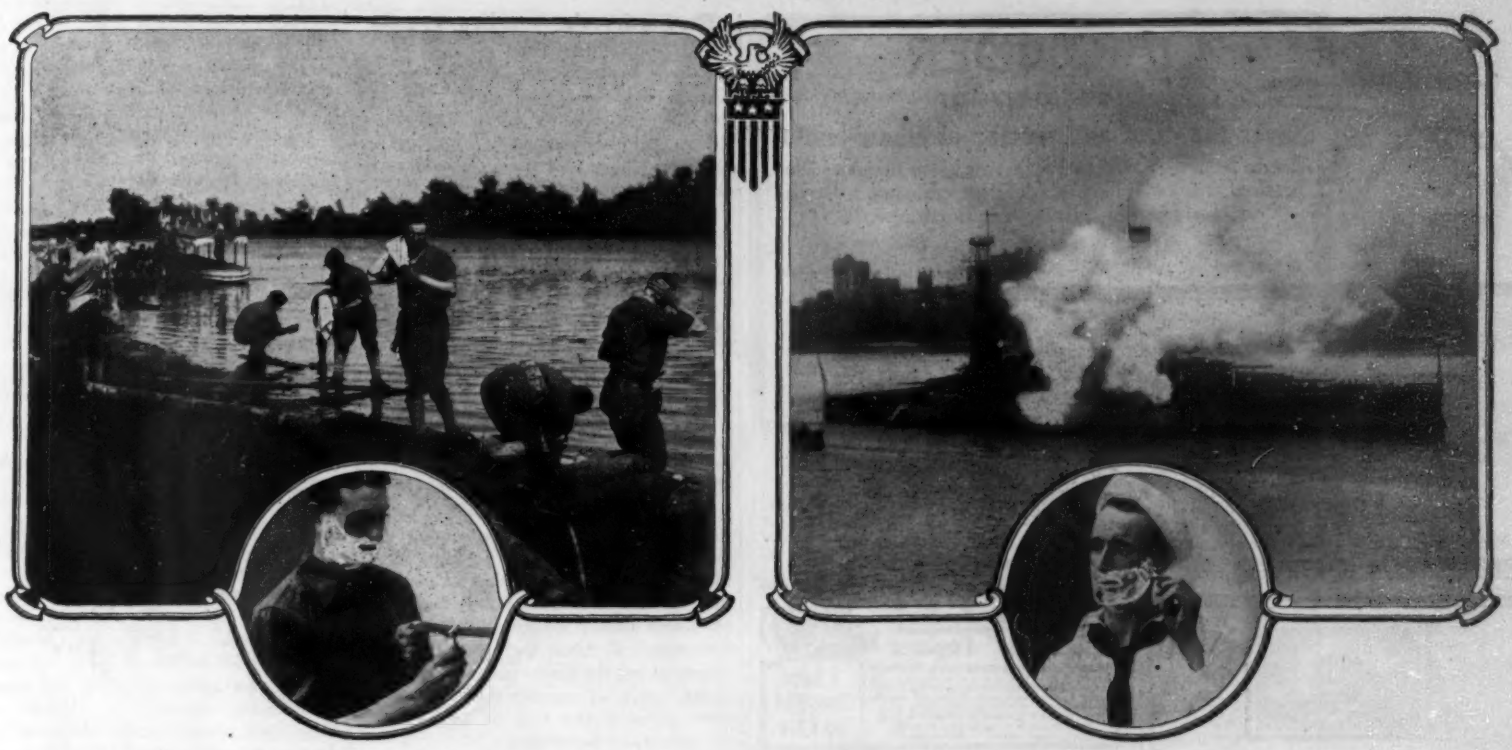
(14237) C. I. G. asks: Will you kindly refer me to any book which gives information on reciprocated dynamos. I refer to the type of machine in which the armature is moved backward and forward rather than rotated. A. We have no references to literature upon a dynamo in which the armature is moved to and fro, by a reciprocating motion, like that of the piston rod of a steam engine. Nor do we know any such machine in use. The effort was made years ago to utilize a motion of vibration in this way, something like the vibration of the prongs of a tuning fork, but without success.

(14238) C. E. C. asks: Have you any information on heating houses by electricity through the use of large tank of water in basement which is heated to boiling point at night during hours when electric plant has light load, and then during the day such hot water being pumped by electric pump to radiators in the various rooms of the building? This electric pump being automatic so that while the water is hot it runs slowly, and as the water cools it operates with sufficient rapidity to heat as desired. If such plants are in use what rate per kilowatt hour can be paid for current and not have the expense exceed $10 per ton for hard coal. This plan is said to be operated in Sweden where from 10 P. M. to 6 A.M. a rate of about 5/16 of a cent per kilowatt is made during these hours. Referring to clothing for aviators, discussed in a recent issue, I have trousers lined with sheep hide wool next to wearer, that render auto driving at zero comfortable. I had them made large enough to go on over regular clothes. They are cloth outside. A. We have no data in reference to the system of heating by water heated in the night by electricity and distributed in the day through the house by a pump. Electricity must be very much cheaper than it has ever been in America to render this system economical or possible. Perhaps some of our readers have knowledge on the matter. Your sheep skin trousers must be very warm and comfortable in zero weather.

(14239) L. W. H. asks: 1. What is the sun? Is it real literal physical fire? Whence does it derive its seeming boundless supply of light and heat energy, and what is the latest theory in regard to its source or method of light energy. 2. Other things being equal, at what instant during the twenty-four hours of the day will a thermometer register the lowest temperature? I should like to know about a recent up-to-date book on General Astromony. A. The best and most recent books on General Astronomy are Young's Manual of Astronomy, and Moulton's Introduction to Astronomy. We send the Young for $2.50, and the Moulton for $2.20. You will find your questions answered in these books. The sun is not on fire. If it were the best hard coal, it would be burned out in not more than 1,500 years. Its energy is believed to be due to its own contraction, although since radium was discovered it has been suggested that this substance may be the cause of at least a portion of the energy of the sun. The coldest time of a day is not at the same instant of the day for any period of time. It is ordinarily at or a little before sunrise.

(14240) C. C. T. asks: I have been informed that to connect iron eave troughs with copper downspouts there is likelihood of electrolysis attacking the iron products in the vicinity of the copper, and the iron would be destroyed. Is this statement correct? If so, what manner of connection could be made to prevent it? A. Your statement is correct that the corrosion of a copper and iron junction is due to electrolytic action of moisture is present. There is no way of preventing this action, excepting to separate the metals, though if a riveted junction of rather thick plates is made the action is so slow that it will be a long time before the junction is opened. An examination occasionally will show when replacing or repair is necessary.

(14241) J. C. A. asks: Will you kindly advise the writer whether or not it ever rains in the lower Nile River Valley in Egypt? A. At Alexandria and along the Mediterranean Coast of Egypt rain falls in the winter. The average yearly rainfall is about eight inches. At Cairo rainfall is very irregular and seems to be due to occasional storms rather than to a rainy season. However, most falls in the winter months, January and February, and none has been recorded in June and July. The average does not exceed an inch and a half. In the open desert heavy storms burst from time to time causing sudden floods and drowning men and animals in the narrow ravines. These are more frequent in the mountainous regions of the Sinai peninsula. See article on Egypt, Climate, in Encyclopedia Britannica, Vol. IX, page 23, Eleventh Edition.



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The Earthquakes and Eruptions in San Salvador

(Concluded from page 76)

perhaps four hundred feet it falls again into the tube while the superheated vapors that agitate the fountain develop majestically into clouds and rise in a column far above the rim of the crater.

In this survey of things as they are, a word or two might be given of the damage wrought in buildings. Perhaps ninety per cent of the habitations of San Salvador were either shaken down completely or rendered unfit for habitation. These are constructed in accordance with a local system known as bajareque and are, in effect, of adobe reinforced with a lattice of poles and cane. The quake shook out the adobe from the mesh and the framework, weakened by decay and the eating of termites, collapsed. The roofs are of a heavy red tile and put an unsafe burden on walls of this sort. Public edifices of heavy reinforced concrete came through in fair condition but systems of cement construction with little iron, fared badly. In particular hollow cement block construction seems ill fitted for earthquake conditions unless the blocks can be interlocked. Construction of lumber and sheet iron came through the test better than the native ones of bajareque.

Water mains were broken in every street in the city and electric wiring was put out of commission. At the first heavy shock the lighting currents were shut off to prevent conflagration and the city continued in darkness for a week. The streets are now lighted as well as many buildings, while the telephones have been reinstalled in the principal business houses.

The poor of the city have not been provided with adequate shelter and thousands are drenched with every rain. It does not seem possible that this state of affairs can continue much longer without serious results. San Salvador itself has lost, temporarily, at least, about 20,000 in population and the return of these after danger has passed will make more difficult the problems of housing and feeding.

Outside of San Salvador the heaviest damage was felt in Armenia and after that Quezaltepeque and Santa Tecla. Crops, especially coffee, suffered heavily on and near the volcano, as a result of a rain of acid at the time of the first eruption.

The total loss of life in the earthquake probably did not exceed 50 but accurate information on this point has not been given out. Had the shock occurred a few hours later the story would have been a different one.

Now for a brief consideration of the causes of this catastrophe. One peculiar fact is to be noted in connection with the opening shocks of June 7th. The first, strong quake, occurring at 6:50 P. M., was the one recorded most widely but it was not the one that did the great damage in the city of San Salvador. This quake was plainly felt through a large part of Central America and was written on the scrolls of delicate seismeters in the United States. It appears to have been coincident with the opening of the new vents and it was clearly responsible for the destruction wrought in Armenia, Quezaltepeque and the other towns north and west of the volcano. Two other shocks followed at intervals of ten minutes.

The greater part of the destruction in the Capital was occasioned by a shock at 9.05 when nearly all the population was in the parks and open streets. An hour or so before this time the illumination of the sky, caused by the outpouring of melted stone in the new vents, was first noted. It is not impossible that a slumping of the earth's crust under the city itself resulted from the release of pressure after a large quantity of lava had run off. A vertical as well as a horizontal movement occurred at this time, and in the ground cracks are said to have opened and closed.

Our cross section of the volcano may aid in an understanding of some of the phenomena connected with the eruption. Just south of the volcano is the Valle de la Hamacos with Santa Tecla on its upper end and San Salvador toward its lower end. On the northern side is a broad plain, averaging more than a thousand feet lower than the above mentioned valley, in which lie the towns of Nejapa, Quezaltepeque and Sitio del Niño. This lower northern base has doubtless permitted steam erosion on the northern side of San Salvador volcano to proceed at a more rapid pace than was possible on the southern side. As a natural consequence the walls of the volcano have become thinner and weaker on this long northern slope. In the present eruption as well as in the earlier one of the seventeenth century the fissures opened on this theoretically weaker side near a protuberance called Jabali.

Among the common people there is the widest possible divergence in explaining the why and wherefore of the earthquake and the volcanic outpouring. Some look upon it as punishment of God because of the infractions of religious law. But more common is the traditional explanation of a secret connection between Lake Ilopango and the volcano. This tradition appears to have connected the Lake of Ilopango with the volcano Izalco, but traditions are mobile and can be shifted to suit the case in hand. When the level of the lake rises the volcano bursts forth. Curiously enough the lake was itself the scene of considerable activity in 1879-80 when some new island craters appeared in it. At that time the other volcanos were not affected and at the present time there are no signs of activity in Lake Ilopango.

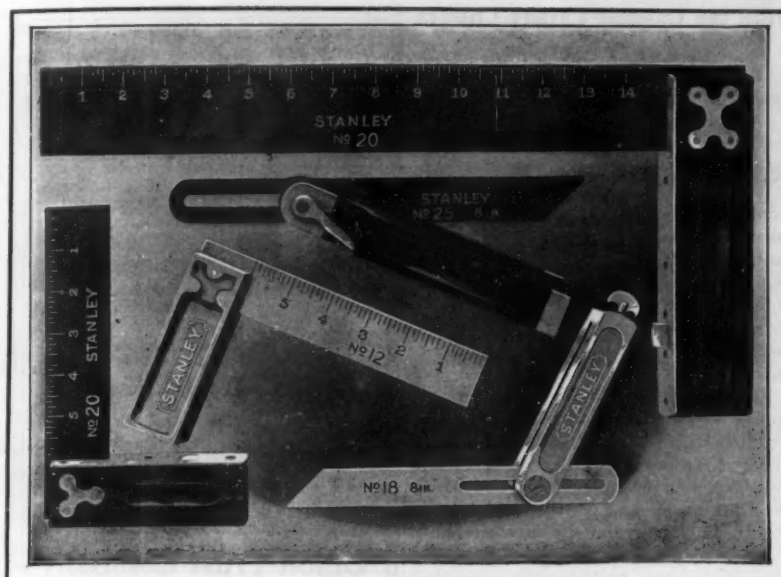
Salvador is in a volcanic belt of great intensity that exists north into Guatemala and south into Nicaragua. The capital of this republic has been destroyed three times in the last hundred years; namely, April 16th, 1859, March 19th, 1873 and June 7th, 1917. The wealth of the country comes from the same source as its troubles—namely, its volcanos.

Use of X-Rays for Examining Reinforced Concrete

RECENT experiments carried on in Europe show that reinforced concrete can be examined by X-rays so as to give a very clear indication of its internal structure and to show the condition of the iron work after a considerable time such as a number of years when the concrete may require to be examined for any possible deteriorations. The use of the X-rays is not only effective but it does not interfere with the structure in any way. The experimenter made use of reinforced concrete slabs of a few inches thickness and containing ¼-inch round iron. The resulting photographs clearly showed the position and arrangement of the iron and the joints, and even the structure of the concrete itself was brought out. These points having been successfully demonstrated, the author made another series of tests in order to show up any cracks in the concrete, and this is of great value in practice because such cracks will admit air or moisture to the iron parts on the inside and cause them to rust. He treats the plate by injections of a bismuth salt or powder in suspension which is well known to be opaque to X-rays, the solution being applied under pressure so as to fill up all the cracks with the bismuth preparation. In this way he was very successful in locating even the finest cracks such as will cause the entry of air to the metal. The present process is one which appears to have a great practical use, and the X-ray method can be applied here without the least difficulty in operating, for it is an easy matter to increase the time of exposure or the strength of the rays so as to secure clear photographs.

Utilization of Waters of Lowlands in Fisheries

AN interesting venture which may open the way to a significant development in the proper utilization of the waters of the lowlands bordering the large streams of the country has been undertaken by the United States Bureau of Fisheries. The director of the Fairport, Mich., laboratory, and the superintendent of the fish-cultural station at Manchester, Iowa, visited Burlington, Iowa, for the purpose of aiding the Crystal Lake Club in developing the fish-cultural possibilities of a large lake in the lowlands along the Mississippi.



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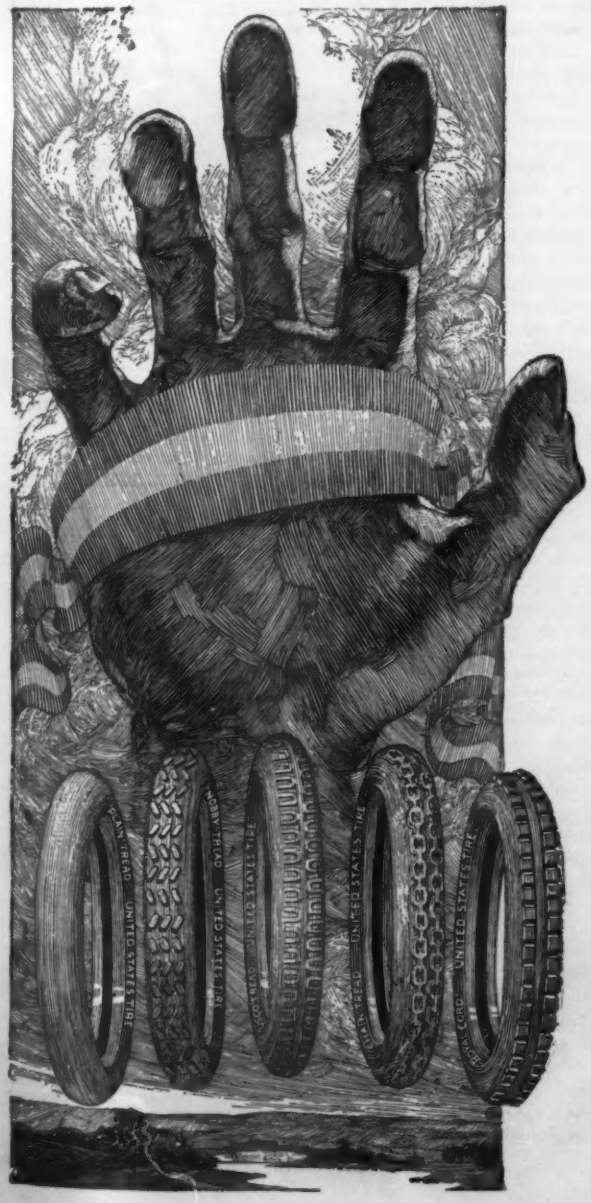
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RESEARCH LABORATORIES OF GENERAL ELECTRIC COMPANY

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When the Gasoline Cavalry Charges

(Concluded from page 79)

There was no element of surprise in the attack of the tanks; for the Germans, occupying all the high positions and possessing excellent observation posts, spotted them the moment they deployed on the ground leading to the slopes of the Craonne plateau. Furthermore, the Germans were well aware of the impending tank attack, for they had made provision in the form of special batteries to be devoted entirely to anti-tank work. These batteries, assisted by large numbers of machine guns, opened a hot fire on the advancing tanks.

The alert German machine gunners, hoping to pierce the steel walls by firing repeatedly at the same spot, poured hundreds of rounds at their targets, and even explored the sides of the tanks with their leaden streams in the hope that a chance shot might find its way through a loophole or peephole, killing or wounding some of the crew, or destroying some vital part of the mechanism. The net result of the concentrated artillery and machine-gun fire was merely the cleaning off of the camouflage paint here and there, exposing the bright steel plates, in the majority of cases.

One tank did not fare so well as its companions. Struck by a direct hit from a heavy German gun, it took fire and in a few moments was transformed into a blazing furnace. Fortunately, its crew was able to open the hatches and jump to the ground, joining a group of infantrymen advancing to the attack. Another tank was brought to a halt in the middle of the battlefield by the breakdown of its mechanism, and despite the efforts of the crew to remedy the trouble, it had to be counted permanently disabled and out of action.

Whereupon the crew, wishing to prevent the possible capture of its ammunition and armament by the enemy, destroyed the ammunition stores and carried off the machine guns. But as the battle progressed this move proved unnecessary; for the French infantry waves advanced far beyond the tank and held their ground. On another occasion a tank was suddenly confronted by a group of daring German grenadiers, who unsuccessfully attempted to destroy the steel monster with their grenades hurled at close range.

Service aboard a tank is anything but a sinecure. It is fully as trying and as dangerous as the work of the aviator or the submarine hand. During actual combat it is said that the crew suffer greatly. Machine gunners, artillerymen and engineers have only the space absolutely necessary for carrying out their work, and only such peepholes and loopholes as are positively required. The commander of the tank sits under one of the turrets, and has a view of the battlefield through a narrow slit; and his spirit, his nerves, his muscles, and his skill are the very life of the tank. When the tank is put out of action; when it meets obstacles; when it fights the enemy—these and many other phases of a tank's work hinge on the skill and decision of the commander. His decision, be it noted, must be made while the surrounding air reverberates with the crash of exploding shells and the artillery and machine-gun reports of his own armament, and while the heavy craft rises and plunges and lurches over the roughest terrain ever crossed by a motor-driven vehicle. Meanwhile the atmosphere becomes intolerable from want of fresh air, and reeks with the smell of burnt fuel, lubricating oil and gun fire. The heat soon becomes oppressive. Of what material the crew of a tank is made, one can readily imagine.

The crews of the French tanks are volunteers. Infantry, cavalry, artillery—in fact all branches of the army, are represented in this service. And it is upon these fearless men that much depends in the modern battle, for the tank has proved a valuable accessory in offensive operations against highly organized positions, and much is expected of its exploitation by both the British and the French armies in battles to come.

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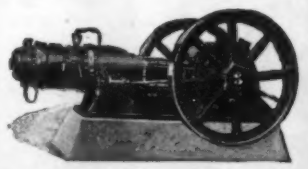

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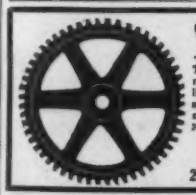

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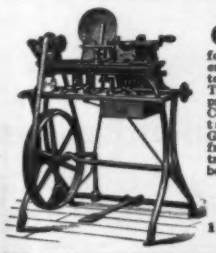

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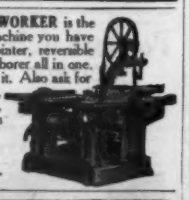

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The Heavens in August

(Concluded from page 80)

There are two or three faint stars, of about the same brightness as the planet, close by, so that he can best be identified by his motion from night to night. Though barely visible to the naked eye, he is conspicuous in a field-glass.

Neptune is just past conjunction with the Sun, and is invisible.

The Moon is full at midnight on August 2d, in her last quarter at 3 P. M. on the 9th, new at 1 P. M. on the 17th and in her first quarter at 2 P. M. on the 25th. She is nearest the Earth on the 3d, and farthest away on the 18th. During the month she passes near Uranus on the 4th, Jupiter on the 11th, Mars on the 14th, Neptune and Saturn on the 16th, Mercury and Venus on the 20th, and Uranus again on the 31st.

Wolf's Comet remains well placed for observation, but is disappointingly faint, and visible only in telescopes. On August 1st it is in 23h. 25m. 50s. + 22° 23′, on August 16th in 23h. 38m. 40s. + 18° 3′, and on September 1st, in 23h. 36m. 20s. + 12° 6′. Early in the month it is almost at the center of the great square of Pegasus. It moves southeastward, then southward, about one-third of the way from the eastern edge of the square toward the western, and at the end of the month is about 2° outside the southern edge of the square.

Princeton University Observatory.
July 30th, 1917.

A Ship with No Reciprocating Machinery

MACHINERY, just like living things, is undergoing a constant process of evolution. Types arise, become dominant, and then tend to disappear before the advance of newer and better adapted types. Though during the progress of one of these cycles it is generally difficult to determine just what is occurring, we appear to be witnessing a most important one today in the gradual conquest of the once dominant reciprocating machine by the rotary type. Thus, the turbine is threatening to displace the engine; the centrifugal pump, the piston pump; the electric locomotive, with its rotary motors, the steam locomotive; and others cases of the same kind can be cited.

In this connection a tank steamer, now under construction in one of the Delaware River ship yards, is of interest behause it is believed to be the first ship to be built without reciprocating apparatus of any kind in its engine room. Its power plant consists of a low and a high pressure turbine geared to a single propeller, a surface condenser with a centrifugal pump driven by a turbine, two centrifugal hot-well pumps also driven by a turbine, and a rotary oil pump for the turbines and gears driven from the main gears.

None of this machinery is novel in principle or application; it merely happens that this is the first time that rotary machinery has been used consistently throughout a ship, thus marking definitely an epoch in the history of shipbuilding.

Undoubtedly, the most interesting feature of the machinery itself is the use of a hydraulic dynamometer to measure accurately the total power developed by the turbines. The two turbines are connected to the propeller shaft by two sets of Westinghouse reduction gears, which permit the 3,600 r.p.m. turbines to drive the propeller at 70 r.p.m. The dynamometer is incorporated in the pinion frames of the first gear and its principle is as follows: The pinions and gears run immersed in oil and act as pumps, causing a considerable flow of oil under high pressure to the reservoir. The frames carrying the pinions of the first gears, while normally bolted securely in place, can be released and are so arranged that they will actually float on the stream of oil flowing from the pinions. The pressure of this oil represents the total pressure on the teeth of the pinion plus the weight of the pinion and frame. Therefore, for the gage pressure of the oil (corrected from the frame and pinion weight) and the revolutions per minute, can be obtained the power transmitted, the sum of the power of both gears giving the total power delivered to the propeller.

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And, your joy'usness increases as the Prince Albert flavor and fragrance begin to tune-your-taste and cheer-the-atmosphere! And pretty soon you realize what's behind this P. A. *satisfaction talk!* You drop to the fact that instead of coupons or premiums *your money buys quality!* That's why Prince Albert meets the universal demand; why its popularity is so great; why it is today smoked in every civilized country!

You certainly can-cut-capers with Prince Albert for your tobacco-buddy! Afloat or ashore, indoors or out, P. A. hands you so much smokefun, such real and true smokesunshine, that smoke-time will be pretty much *all-the-time* as far as *you're* concerned.

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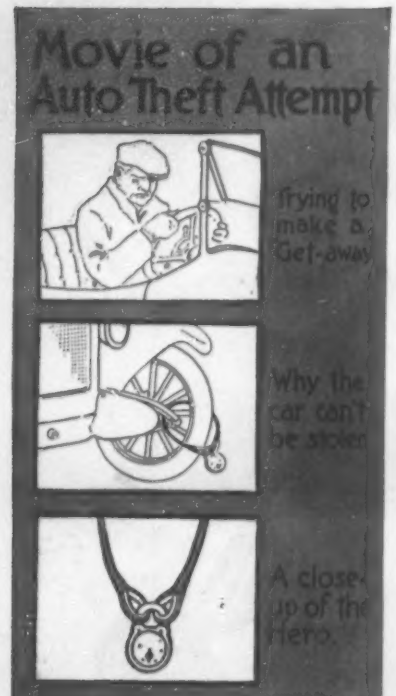

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A Neutral Zone in the Campaign Against an Insect Pest

A NEUTRAL zone between belligerent nations or armies or football teams is a familiar expedient to reduce either the probabilities of actual clash or the resultant fatalities. If the Department of Agriculture has its way, we shall have a neutral zone of a somewhat novel character along our southwestern frontier, as a means of protection for our cotton fields against the dangerous pink boll worm which is prevalent in Mexico.

Addressing Committees of the House and Senate, Secretary Houston recently stated that this pest is much more widely distributed in Mexico than was at first supposed. It now extends throughout the Laguna district, covering an area of some 12,000 square miles. Seed for planting has been sent from this district to other points in Mexico nearer the United States, undoubtedly carrying infestation to those districts. The danger to our cotton has now been heightened by the establishment of a cotton-seed oil mill at Piedras Negras on the border, to which large quantities of seed infested by the worms are being moved. Investigations by the Department's specialists show that mature insects capable of flight over considerable distances have been emerging from the seed stored at this place, within a few miles of Texas cotton fields.

Importation of seed cotton and cotton seed from Mexico into the United States was prohibited as soon as the presence of the pink boll worm in the former country was discovered late last summer. In addition the importation of cotton seed products will be safeguarded by regulations to be issued immediately. It is now requested that an emergency appropriation of $500,000 be made at once available for the purpose principally of creating a cotton-free zone fifty or a hundred miles wide in Texas along the Mexican border. The proposed zone would be established in coöperation with the State of Texas, the State officials already having indicated their desire so to coöperate. The growing of cotton therein would be effectually proscribed by the laying of Federal and State quarantines prohibiting the movement from the State or within the State of any cotton grown in the zone. While some four thousand bales are ordinarily produced in the area to be included in the zone, most of the tillable land is well adapted to the cultivation of sugar-cane, rice, vegetables and other crops.

Eventually it is hoped to coöperate with the Mexican government in the destruction of the pest in that country. Until this can be arranged, however, and the work of extermination carried to a conclusion, the proposed zone seems to offer the most satisfactory means for its exclusion from our territoy.

Why is the Tinned Sheet-Copper Roof of the Library of Congress Corroded?

THE Bureau of Standards has recently investigated a rather unusual and interesting case of corrosion, namely, that of the roofing material of the Library of Congress. The roof of this building has been covered since about 1893 by tinned sheet-copper which has become covered within the last ten or fifteen years with small pits; in many cases these pits have extended completely through the sheet. Such a condition is interesting, particularly in view of the fact that Washington is uncommonly free from smoke and other elements which are understood to be a strong accelerating factor in corrosion. The investigation has shown that the corrosion was due to no accidental inferiority of the material, but that it is to be considered as characteristic of all material of this type. It, therefore, appears that tinned copper is not superior in any way to tin plate for roofing material and that in view of its greater cost can no longer compete with it.

Tinned sheet-copper is used also for containing vessels such as milk cans and for fittings such as troughs, etc., for soda fountains and breweries. It is probable that such articles would also be subject to pitting corrosion of the same type if they are not worn out by actual abrasion before the corrosion proceeds far.

Superior Bread Baked from Banana Flour

THE Horticultural Club of Trinidad has arranged to have loaves of bread baked from banana flour prepared at local bakeries and offered for public sale in order that the people may have an opportunity to know that a most palatable bread can be made from banana flour.

At a recent meeting of this club samples of banana flour and bread were exhibited and the method of preparation described. It was explained that the bananas from which the flour and bread were made had been taken from trees only five days previously, the "silk fig" small variety of bananas producing the best results.

The process was described as follows: Full-grown bananas should be selected. Peel, slice, and dry quickly, preferably on a galvanized sheet, then grind in ordinary corn meal. From 63 pounds of green bananas, 16½ pounds of flour had been obtained in the specimens shown. The bread, which was very palatable, had been made from two parts of banana flour and one of wheat flour. The banana flour could also be used as a substitute for oatmeal porridge and also for making puddings.

Reckoning the cost of the bananas used in the above experiment at 30 cents and the labor for preparing into flour at 20 cents, it had cost 50 cents, equal to about 3 cents per pound.

The London *Lancet* was quoted as stating that banana flour is more digestible and contains more nitrogenous matter than wheat flour; also it could keep for a considerable length of time. It was also stated at the meeting that plantains could be made into flour in the same manner, and such flour was very nourishing for children. Reference was made to the fact that such flour was exported from British Guiana and was known as "bannanine."

Whale Meat as a Solution of the High Cost of Living

THE Bureau of Fisheries, Department of Commerce, has for some time, in correspondence and in personal interviews, been advocating the use of the meat of whales, porpoises, dolphins, and other cetaceans for human food.

Whales and porpoises are mammals, like cattle and sheep, and their flesh is "meat" and not "fish." In texture and appearance it resembles beef, though the color is darker red, and the flavor is closer to that of meat than to any other. It is devoid of all fishy taste. It is likely that it will soon be obtainable fresh, corned, and canned, and it is recommended to those who have the opportunity to purchase it.

Whales are taken at several shore stations on the Pacific coast, where their blubber is rendered for oil and their bones and flesh used to some extent for fertilizer, while their skins appear to be adapted to tanning into leather. These stations take a considerable number of these animals, each furnishing about five tons of excellent meat.

Porpoises are abundant on all of our coasts, and there is a regular fishery for them at Cape Hatteras, where they are valued principally for their oil and to some extent for their hides.

During May an enterprising whaling company placed fresh whale meat on the market in Seattle, Wash., and Portland, Ore. The product met with a ready sale at 10 cents a pound, and was immediately placed on the menus of the hotels and restaurants under its proper name.

Introduction of Foreign Plant Diseases

DURING the year 1916 the Federal Horticultural Board found 157 different insect and fungus diseases on the plant material imported for scientific purposes by the U. S. Department of Agriculture. This was the result of a much more rigid inspection than is given to plants imported for commercail purposes, and indicates the true extent of the danger.

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